PROCEEDINGS

OF THE

THIRD ANNUAL MEETING

OF THE

NORTH CENTRAL WEED CONTROL CONFERENCE

DES MOINES, IOWA

DECEMBER 11-12-13, 1946

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## PREFACE

The following consists of the main proceedings of the 3rd annual meeting of the North Central Weed Control Conference held at the Savery Hotel, Des Moines, Iowa, December 11-12-13, 1946.

The total attendance was 367 of which 262 were registered compared with 191 registered last year. Reports were well presented and the whole conference was an outstanding success. On Friday, the last day of the conference, due to stormy weather the discussions were held to a minimum so the delegates could start home earlier than first planned.

The appreciation and thanks of all members and registrants of the Conference go to the following donors who so generiously contributed to financing the conference.

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| Iowa Seed Dealers Association | Des Moines, Iowa |
| Western Feed and Grain Dealers | Des Moines, Iowa |
| International Harvester Company | Des Moines, Iowa |
| Iowa State Soil Conservation Committee | Des Moines, Iowa |
| Iowa State Department of Agriculture | Des Moines, Iowa |
| Des Moines Chamber of Commerce | Des Moines, Iowa |
| Farmers Grain Dealers Association | Des Moines, Iowa |
| Essick Manufacturing Company | Los Angeles, California |

The Iowa committee on arrangements for this meeting were Clyde Spry, A. L. Bakke, and E. P. Sylwester.

A. H. Larson
Secretary-treasurer

THIRD ANNUAL MEETING

NORTH CENTRAL WEED CONTROL CONFERENCE

On Wednesday afternoon, December 11, 1946, the opening session the North Central Weed Control Conference was held in the Hotel Savery, Des Moines, Iowa.

President Yost: Gentlemen, I believe it is time we are going ahead with our program. We have two very important addresses to be made by Iowa people. We are very glad to have Mr. Harry D. Linn, Secretary of Iowa Department of Agrilcutre, to give the opening address, Mr. Linn.

ADDRESS OF WELCOME, HARRY D. LINN, SECRETARY OF AGRICULTURE, IOWA

Mr. Yost, ladies and gentlemen. My address is going to be short. I am very glad to welcome this group to Iowa and to Des Moines and I think you already know that you are most welcome to this State and to this city. We are very happy to have this type of conference here. We would be glad to welcome a group of cattlemen and could tell them that I was welcoming them to the center of the cattle feeding industry of the United States, a group of corn growers to the center of the corn growing area of the United States, hog prcducers to the center of the swine producing area of the country but I am a little hesitant as to welcoming to this area the weed men.

We here in Iowa, are very much interested in the control problems of weeds among our crops and on our good farm land. We are very much interested in the work that you folks in the Experiment Stations and Colleges are doing with these various new chemicals in weed control. I might say that over on the State House grounds we have a weed problem. We now have a Republican administration and we say that the Democrats left the condition and they say the Republicans got it that way. We have been very interested in and happy to try out some of your 2-4D products. I might say that this past fall, I have had many complimentary remarks from over Iowa that the State House grounds look better than ever before. Advice that we get from you folks in Experimental Stations and folks that are interested in putting out new products are going to revolutionize control of weeds. We are also interested in Soil Conservation, proud of our soils. We are losing some of this good top soil and are afraid weeds are costing our farmers a great deal of money that they shouldn't be losing. Throughout the state, we have been tying in weed control with soil conservation which we think is very important.

I am not going to take a lot of time. I know you want to hear our friend, Kirk Fox, outstanding agricultural editor of our country. In closing, let me say we are glad you came to Des Moines, glad you are here in Iowa and if we can do anything to make your stay more pleasant, we shall be happy to do so.

President Yost. I am sure, Mr. Linn, that we all appreciate that warm welcome. We have no response speaker but we want Iowa to feel that it is an opportunity and a privilege to meet in this swell city in this wonderful state of Iowa.

I think we are fortunate to have as our speaker Kirk Fox of Successful Farming. He is probably the outstanding editor in the country. We will be happy to listen to Kirk Fox at this time.

WEED CONTROL FROM AN EDITOR'S POINT OF VIEW
By Kirk Fox, Editor, Successful Farming

Iowa has been quite appropriately chosen as your meeting place for this year. After you have been with us for two days, you will have learned that this is the state where the tall corn grows. The famous song of that name may eventually have a verse added claiming superiority on the height of weeds as well. It is one of the ironies of life that where corn grows tall, weeds grow just a little bit taller.

But we are always eager to do better in this famous state, and as soon as supplies are available we will add hundreds of thousands of tons of commercial fertilizer to our black soils, so that the weeds may have even greater opportunities to grow and multiply. Last spring I visited a farmer in central Iowa who was applying a concentrated nitrate fertilizer to his cornfield for the first time. Naturally, some was spilled along the headlands. When I returned later in the season to check on the progress of the corn, I was astonished by the height of the horse weeds which had been so quick to find a specially fertile spot. Frankly, I am disappointed, because I had worked on the theory that if we could make all of our fields fertile enough, the crops would smother out the weeds. Evidently, I have learned my lesson. Weeds are quicker to adapt themselves to new setups and new conditions than we are to meet them with control measures. With the modern tractor and plenty of power it seemed certain our farmers would soon put weeds out of their lives forever. Then we began to discover patches of dogbane Russian knapweed, and similar pests that were able to maintain a defense system in the soil far below the mechanical offenses set up by man. Now we are involved in a nation-wide search for chemicals effective in penetrating the tissue of the plant to its very innermost defenses and killing it there.

Weeds are already costing every farmer in the United States $450 every year. But since we have all learned in recent years to deal in at least five figures when discussing financial matters, there seems to be a well organized program among farmers to "up" that insignificant $450. Authorities from a neighboring state are the source of my information that, "the total weed seeds planted today by farmers exceed any other single crop planted in that state!" Perhaps instead of weed experts, this conference should be directed by a bunch of psychologists. Certainly it would be interesting to know all of the mental processes thru which a farmer progresses in order to reconcile himself to such voluntary traffic in weed pests.

During your sessions, state officials will endeavor to show us why we need stronger state and federal laws to safeguard commercial seed supplies. I am for them. We cannot overlook, however, the very large traffic in weeds between farms that occurs every winter. Until farmers have been thoroughly aroused against the weed nuisance, this must be a major source of weed infestation. Please bear in mind that a high percentage of our farmers do not expect to operate the farms on which they are spreading seed next spring for more than two or three years. Why should they be specially worried about the weeds some other man must fight? Certainly some other fellow is spreading weed seeds on the place they will be farming three years hence. And so we have the vicious circle.

Few men, I am sure, look upon commercial feed and hay as a potential source of weed seed. Not long ago Clyde Spry told me of a call he had received to a farm where bindweed was suspected. Identification was easy, for there was a band of this noxious weed the width of a manure spreader straight across the field. Questioning revealed the fact that the load was obtained in a poultry house where a low grade of chick feed had been fed that spring. The owner admitted that the chicks had refused to eat a considerable amount of it. While I am not one who is eager to demand a law every time I see a new problem, I do commend to you careful study of the Kansas legislation relative to feeds. Merely fighting the weeds after they have arrived is bound to be slow work and exceedingly costly work. Under the administration of J. C. Mohler, commissioner of agriculture, and our chairman, Ted Yost, Kansas millers and feed dealers have proved very friendly and cooperative. The installation of machinery for grinding weed seed beyond any possibility of germination has been gratifying, indeed. Iowa may not import a great deal of hay, but I do see its influence on weed populations in states farther to the East where this crop must be imported.

Were I to extend my remarks to include all of the ways by which a farmer introduces weeds to his farm, I would be repeating a lot of commonplace information to you officials, manufacturers, and research specialists. However, I must touch briefly upon the very great increase in custom machinery operation. Not only is this work done within the community, but is extended from Texas to the Canadian line and beyond. Inevitably there must be infestation unless full precautions are taken to clean such equipment. The movement of second-hand machinery during the next year or two will be an equally serious threat. Much of the burden of drying up sources of infestation will naturally fall upon our state officials. I would urge that they take farmers and farm organizations into their fullest confidence. Explain your problems and how you are trying to solve them. Farmers enjoy the relaxation of short inspection tours. Rarely does a group get together for any purpose without a few men driving in some mysterious plant growth they have found in their fields. They hope to find someone able to identify the plant before it becomes a weed pest. Such tours must include representatives of the press and the radio. Your speaker still entertains most pleasant recollections of a two-day trip across the state of Kansas with Jake Mohler and Ted Yost. I have had similar pleasant experiences in Iowa, Nebraska, and North Dakota.

But when the enemy has once become firmly entrenched in our fertile soil, the time has arrived to call in the research specialist. His labors have already borne such promising fruit that farmers are no longer willing to swing a scythe in the weed patch when the temperature is hovering around 100 degrees. I wonder sometimes if our weed enforcement officials fully understand research and all that it can do for them. An investigation at the University of Iowa within the last few weeks reveals the regrettable fact that fifty outstanding citizens in an Iowa community of 15,000 when interviewed at length indicated they did not understand what is meant by research, that they did not consider research important, and that they did not look upon it as an important method of solving problems. Here is something evidently wrong. Our citizens have heard much about the results of research but very little about how much it represents in money and human toil. The mechanics of developing a chemical or a piece of machinery capable of coping with the weed pest, I am afraid, are ittle understood by the rank and file of our farmers. There is a practical angle to this, since funds for continued work must come to a considerable degree thru the appropriations of our state legislatórs and Congress. Our scientists have been too busy, our editors too much engrossed in other things to emphasize the train of endeavor responsible for all worthwhile scientific achievement.

Personally, I am deeply impressed by the possibilities of the Hope-Flannagan research bill. Truly a bipartisan piece of legislation, we may confidently expect it to function regardless of the political party in control. The enormous sums of money, so far as public appropriations go, represented in this legislation will eventually bring together great numbers of scientists equipped with the most modern laboratories. We can properly hope this work will be guided in the future by broad-guaged men, men who appreciate the need for a closer link between the public research laboratory and commercial research. This summer I visited at least six large research projects set up by private organizations interested in finding new uses for their basic products or in broadening the line of business in which they are now engaged. Into these laboratories are being drawn some of our finest college technicians. We may hope their work will be conducted at all times on such a plane that there may be friendly interchange of techniques and information between public and commercial workers. God know there's a need for greater interchange of ideas among public research workers.

I was tempted to list in detail the significant new defense lines thrown up against the invading green army of weeds. Were I to do so, it would be again repeating many commonplaces to you men expert in this field. Certainly chemicals have enjoyed the lime-light. In fact, the chemist has tossed so many new things into the mill the last few years that editors must employ experts and assistant experts to keep reasonably well informed on all of them. I recommend for your consideration the Michigan Insecticide-Fungicide Institute recently formed. Dealers in these products, realizing their dependence upon each other, formed an association October 1 for the purpose of standardizing recommendation of state and federal extension agencies, manufacturers, distribu-

tors, and dealers; to encourage the use and proper methods of application of agricultural chemicals new and old; the promotion of more efficient methods of distribution of all products by the members through the use of better business practices; the fostering of mutual understanding and respect among all those engaged in distribution of agricultural chemicals; and sponsoring proper regulation of agricultural chemicals by effective legislation and enforcement.

In Mason City, Iowa, today and tomorrow, the commercial vegetable growers are in annual session. Permission has been obtained from city police to demonstrate a flame weeder in the streets. A new type of sprayer for distributing oils on carrots will be exhibited, along with a Tillivator, something very new in mechanical weed control. In California, heavy equipment for administering electric shock to weeds is now being manufactured on a commercial basis. Were I younger and less hard-bitten by facts, it would be easy for me to stick my neck out by forecasting that weeds would soon be erased from the face of the earth forever. With due respect to the able and efficient men assembled in this hall, I dare not go that far in my lifetime, at least. However, the day is at hand when great acreages of farm weeds and brush will be effectively killed by chemical sprays or dusts.

I have previously indicated that the multiplicity of chemicals and machines at times leaves the editors a bit confused. What must be the state of mind of the average citizen? In weed control, we are about at the point where we were twenty years ago with household gadgets. You all recall the old joke about the wife who called her husband at the office to say something terrible had happened in their home. The radio was covered with frost and the icebox was playing jazz music. When the farmer starts getting his chemicals mixed the results are not going to be funny. And so along with better legislation, which may mean fewer laws, and a greatly accelerated research program, there must grow a huge public relations job between you men and your public. Quite naturally, I would plug my own line at this point. If no other point in my remarks up to this time has remained with you, let me bear down with special force on this one! KNOW THE PRESS AND RADIO FOLKS.

A young editor from a farm publication came to me at a scientific meeting recently. The man sitting next to him, who evidently had spent most of his life up to that point in a research laboratory, had looked at this boy's name card and business connection and remarked "Is that some kind of a farm paper?"

Let me give you a picture of the typical reading sources of a Midwest farm family, the one you men here assembled are primarily interested in reaching. It has three farm publications. This does not indicate duplication, since one is usually of a general type, another a state paper, and the third a special breed or fruit publication serving that farmer's special interests. There is a local weekly newspaper for the community personnel now. There is a news daily,

and in 92 per cent of the homes, a radio from which the farmer obtains 85 per cent of the general news There are very few urban magazines of any kind per 100 farm homes. There is an average of one new book per family per year, and two borrowed library books per family per year Then there are the college bulletins and manufacturers literature.

Like the farmer, the editors of these publications, as well as the editors of the radio stations enjoy tours. They should be included in every meeting and every tour. Few care to be officially included in committees or organizational setups, but they do enjoy being remembered with invitations. Farmers are the last segment of our population that reads a great deal of serious material. Many surveys indicate their publications are much more carefully read than the urban magazines. Through the sources I have indicated, you will be readily accepted in all farm homes. I beg of you to leave your scientific terminology in the laboratory and give these editors the results of your work in language used by the man in the fields I am fully conscious of the fact that some editors will overwrite their information. Having grappled with scientific jargon for nearly thirty years, I can understand how some of them have been led astray unintentionally. Seldom does an editor have unanimous approval of scientists on anything. It is a health condition when honest men disagree. But do not be too hard on the editor when he published something that you personally think may be overcolored. Your brother scientists may feel differently.

After all, the press and the radio are operated by human beings who vary in temperament. This avenue of approach to public thinking is too important to avoid because there are a few who insist upon speeding over its well-finished surface. The speeder can be controlled or snubbed. The conservative, who has a record for presenting scientific material accurately and fairly, can be encouraged. I am convinced, if the vast new body of research information soon to be released to the public is to justify its cost that research enforcement officials, and the press and radio must demonstrate teamwork such as we have never had before.

President Yost. Mr. Fox, I am sure I express the sentiments of this group in thanking you for taking the time to come over and address us and the same for Mr. Linn. We appreciate that you men are very busy and that it is hard for you to find the time to meet with us. We want to invite you to attend any or all of our sessions or any of your co-workers We will now adjourn and go to the first regular session of the conference. Mr. Clyde Spry is to be the Chairman. We will stand adjourned.

WEDNESDAY AFTERNOON SESSION

Chairman Spry. The meeting will please come to order. We are a little late in starting the afternoon session but from now on, we hope to keep on schedule. Without any formalities, I will call on President Yost who will give his address at this time.

## PRESIDENTIAL ADDRESS BY T. F. YOST

This is the Third Annual Meeting of this Conference. As an organization we are, indeed, still young. As an organized group, we are now actually finishing only our second year of existance. During this period we have, at least, gotten acquainted so that we can work together better. We have met together several times and have discussed some of our common weed problems as they exisit in our area. This has served to give each of us a better understanding of the weed problem in our neighboring states. This should make us better able to work together in future years.

In the short period during which we have worked together, I would say that we have certainly made some important gains in a forward direction. We have all been intensely interested in the activities and findings of our Research Committee. Much of the progress we make in our state weed programs will be based on the findings by these workers. As President of the Conference, I desire to congratulate the Research Committee for the splendid manner in which they have worked together on the uniform research program in order to obtain the most and best possible information in the shortest possible time on that most interesting subject of 2-4D. We will all agree that 2-4D has advanced weed control work over the nation many fold. It has opened a new approach to at least a partial solution of the whole weed control problem.

In spite of all the wonderful things we can say about 2-4D, it is in my opinion not the perfect weed killer that so many had hoped for or that it was advertised to be. It lacks much from being a cure all to the complicated and many sided weed problems. May I urge this whole army of weed workers not to throw overboard the old standard, tried and proven weed chemicals such as sodium chlorate, borax, carbon-bi-sulphide, and other chemicals of long duration. Please pardon the following reference to my own state. During the past year, Kansas has used more sodium chlorate than in any previous year. It is our present opinion that we will continue to use large amounts of chlorate for killing of deep rooted perennials weeds. Neither should we think of discarding the tillage and crop competetive methods that have proven so effective and have many advantages, until we are certain that we have better methods and better killers.

2-4D has already found a large place in weed killing where, in certain uses, it stands in a class by itself--I refer to lawns, parks, cemeteries, golf courses, and other similar places. In our state we have gone to the extent of legally approving the expending of local and state tax funds in the use of 2-4D for the treatment of bindweed and hoary cress when found growing in good stands of perennial sod grass for competetion. In like manner, our state has legally approved the use of Borax for the treatment of deep rooted perennial weeds when found on highways, railroads, and other similar places not devoted to the production of grasses or tilled crops. It is our opinion that Borax or Borascu is superior to sodium chlorate or 2-4D for killing such weeds in such places. In addition, I would like to say that research has and will find more and greater uses for 2-4D as a weed killer without declaring it

to be a perfect herbicide for all weeds under any and all conditions and circumstances to the exclusion of the tried and proven chemicals and other methods of treatment for control and eradication

On behalf of this entire conference, may I take this opportunity to give special thanks to all of the committee chairmen and their members for their splendid efforts and cooperation during the past year.

I desire to officially welcome to this conference, our friends and delegates from the Western Conference. I desire to give a special welcome to our friends and workers from Canada. It is my sincere hope that they may be included as a part of our conference if it is their desire and wish.

I desire to welcome those who are here representing federal agencies We consider you as a part of our conference and certainly need your help and cooperation in better handling the weed situation in our area and in each of our individual states.

Last, but not least, I desire to welcome those who are here representing commercial agencies such as chemical and equipment companies. Your part in the fight against weeds is indeed as important as is the work done by research workers and also those who have charge of state control and eradication programs. With your cooperation, our efforts would be much less fruitful.

As a conference it is our desire that all agencies including research, both federal and state workers, state control and enforcement officials, all federal agencies having weed problems and all commercial agencies selling weed chemicals or equipment should work together as one body and should move forward as one force for the common good and to the best interest of those who are afflicted and troubled by weed menace.

In closing, may I say, we are indeed glad that you are here and we hope that you can remain throughout the entire conference.

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## REPORT OF PRESIDENT WHO ATTENDED THE 1946 MEETING OF THE WESTERN CONFERENCE AT RENO, NEVADA IN FEBRUARY, 1945

At this time, I desire to report on my trip as your delegate to attend the 1946 meeting of the Western States Weed Conference which was held at Reno, Nevada during the last week of February.

As you already know, the Western Conference comprises the eleven Rocky Mountain and Pacific Coast States. I believe that all of the states were represented at the meeting excepting Arizona and New Mexico You also know that our conference was patterned very largely after their organization. In view of that fact, I think I am safe in saying that these two conferences are func-

tioning in very much the same manner; the principal purpose being to exchange ideas and to further the interests of weed work in any practical and feasible manner.

The weed problem in their states are different in one main essential from the weed problem in our area which is that their biggest weed menace exists under an irrigation system of farming. A list of their worst weeds, would contain about the same weeds as are found in our area with slight differences in comparing individual states. The western area has complicated weed problems in connection with the U. S. Controlled Forest Service, and grazing lands, the federal reclamation lands, as well as the Federal Indian Service lands. The weed problem in these three classes are, of course, almost non-existant in our area when compared with the western states.

In my opinion the Western States have excelled the central states in developing better methods of control and conducting wide scale programs for the handling of the annual weed problem in small grain crops and also in handling annual weeds in specialized crops such as vegetables, sugar beets, etc. Since irrigation is the backbone of agriculture in the western states, and since the perennial weed problem is aggravated and intensified by irrigation methods of farming, the leaders in the western area, are in my opinion, more wide awake to the weed menace than are the leaders in some of our central states.

The weed men in the western states are a hard hitting group of workers. Their research workers are out to get the facts to meet a given situation in as short a time as possible consistant with good research methods. Their botanists, physiologists. and agronomists are of the new modern school that are in the business of developing practical methods of control and eradication for their orchardists, farmers, and ranchers.

The program of the Reno meeting was well planned and presented. As would be expected, 2-4D carried the spot light. Consideration was also given to Range Weeds poisonous to livestock, to Reclamation and Forrest Weed Problems, and other phases of weed work such as spray equipment The program as well planned to cover their present day weed problem. Their conference program was largely presented in the form of panel discussions. I believe the panel method of presentation to be an excellent method to use in our conference meetings. In closing this report, I desire to thank each member of this conference for the opportunity of acting as your delegate to the Western Conference Meeting. The trip and the meetings were fully enjoyed and I trust that my efforts to assist our conference will, in a small way, repay for this experience. I sincerely thank you.

President Yost. The next thing on the program, gentlemen, goes under the head of introductions, and at this time we would like to take time to see that everyone is properly introduced. I think it is very desirable and very important that everyone feel at home and acquainted. There are alot of people that are strange to each other and I think we ought to get acquainted as much as we can, so at this time I would like to ask that we introduce ourselves or be introduced by someone of your group.

## REGISTRANTS

| Name | Address | Representing |
|---|---|---|
| Aamodt, T. L. | St. Paul 8, Minnesota | Minn. Dept. of Agriculture |
| Abels, C. | Grundy Center, Iowa | Grundy County Supervisor |
| Abrahamson, Paul E. R. | Minneapolis, Minnesota<br>314 New Chamber Commerce | International Elevator Co. |
| Amstead, Phil | Scranton, Iowa | Supervisor Greene Co. |
| Anders, Hugh | Des Moines, Iowa | Anchor Serum Co. of Iowa |
| Anderson, Ray | Philadelphia, Penn. | Farm Journal |
| Ausman, L. V. | Pierre, South Dakota | Dept. of Agriculture |
| Ayres, Lee H. | Winona, Minnesota | McConnon & Company |
| Baker, Raymond | Johnston, Iowa | Pioneer Hi-Bred Corn Co. |
| Bakke, A. L. | Ames, Iowa | Experiment Station |
| Balcom, Robert B. | Washington, D. C. | Bureau of Reclamation |
| Ball, Walter S. | Sacramento, California | State Dept. of Agriculture |
| Barnes, Joseph E. | Bloomington, Illinois<br>1300 W. Washington | Funk Bros. Seed Company |
| Barr, C. Guinan | Lansing, Michigan | John Bean Mfg. Co. |
| Barrons, Keith | Midland, Michigan | Dow Chemical |
| Bayne, Kenneth M. | Kansas City, Missouri | Sherwin-Williams |
| Benham, John F. | Chicago, Illinois<br>Board of Trade Building | Nat'l. Sprayers Duster Ass'n. |
| Berggren, Fred H. | New York City, N. Y.<br>19 Rector Street | Oldbury Electro Chemical Co. |
| Berggren, George H. | Harrisburg, Penn. | Agronomy Extension-State College |
| Berset, Merrill E. | Minneapolis, Minn. | Northrup King & Co. |
| Bibbey, R. O. | Saskatoon, Canada | Dom. Department of Agr. |
| Birt, Fred C. | Winnipeg, Canada | Chipman Chemicals Ltd. |
| Boever, John P. | Le Mars, Iowa | Weed Commissioner |
| Bowman, C. C. | Topeka, Kansas | Bindweed Control Ass'n. |
| Boyd, Frederick T. | New York City, N. Y.<br>30 Rockefeller Plaza | American Cyanamid Co. |
| Boyd, Robert B. | Niagra Falls, New York | Oldbury Electro Chemical Co. |
| Brady, Wm. R. | Des Moines, Iowa | U. S. Dept. of Agriculture |
| Brandenburger, R. L. | St. Louis, Missouri | Ralston Purina Co. |
| Brandes, Gordon A. | Grand Forks, N. D. | Agricultural Supply Co. |
| Briggs, George M. | Madison, Wisconsin | University of Wisconsin |
| Brown, Clair A. | Baton Rouge, La. | Louisiana State Univ. |
| Brown, G. R. | Omaha, Nebraska | Miller Chemical Co. |
| Buchholta, K. P. | Madison, Wisconsin | Univ. of Wisconsin |
| Burdett, Paul E. | Lombard, Illinois | Swift Road |
| Buskirk, G. Clare | Lincoln, Nebraska | Dept. of Agriculture |
| Carlson, Arne E. | Wilmington, Delaware | E.I. DuPont & DeNemours & Co. |
| Carroll, Francis E. | Racine, Wisconsin | Agricide |
| Carter, A. S. | W. Lafayette, Indiana | Purdue Agr. Expt. Station |
| Carver, John W. | Chicago, Illinois | Dow Chemical Co. |

| Name | Address | Representing |
|---|---|---|
| Catherwood, James U. | Waterloo, Nebraska | J. C. Robinson Seed Co. |
| Chittenden, Dudley B. | Ames, Iowa | Iowa State Highway Comm. |
| Christie, R. C. | Kansas City, Missouri | Accessories Manufacturing |
| Cleveland, C. R. | Chicago, Illinois | Standard Oil Company |
| Cobb, J. Stanley | Harrisburg, Pa. | State College of Pa. |
| Coffin, Leon | Hereford, Texas | |
| Cowan, E. Karl | Hoboken, New York | Standard / gr. Chem. Inc. |
| Cross, C. B. | Grinnell, Iowa | Ahrens Hybrid Seed Corn |
| Cuff, Ray L. | Chicago, Illinois | Nat'l. Live Stock Exchange |
| Culver, B. C. | Kansas City, Mo. | American Cyanamid Co. |
| DeAtley, L. S. | Kansas City, Mo. | Thompson-Hayward Chem. Co. |
| Derscheid, Lyle A. | Brookings, S. D. | S. D. State College |
| Deyheimer, Donald | Charles City, Iowa | Dr. Salsbury's Laboratories |
| Dhainin, John S. | Des Moines, Iowa | Dhainin Spray-Service |
| Dodge, Donald H. | Ida Grove, Iowa | Ida County Farm Bureau |
| Doolittle, John | Charles City, Iowa | Dr. Salsbury's Laboratories |
| Dougherty, Isaac | North Collins, New York | Associated Chemists, Inc. |
| Dunham, R. S. | St. Paul, Minnesota | University of Minnesota |
| Dutton, W. C. | Midland, Michigan | Dow Chemical Company |
| Ebers, Herman W. | Seward, Nebraska | Nebr. Crop Improvement Ass'n. |
| Ehrensing, Alvin T. | St. Louis, Missouri | Monsanto Chemical Co. |
| Elder, W. C. | Stillwater, Oklahoma | Oklahoma A. & M. College |
| Evans, Lewis S. | Washington, D. C. | Plant Industry Station |
| Evans, Marshall | LeSueur, Minnesota | Minnesota Valley Canning Co. |
| Evans, Sterling | Middleport, N. Y. | Niagara Sprayer & Chem. Co. |
| Evans, W. G. | Ontario, Canada | Ontario Agr. College |
| Farleman, M. G. | Elizabeth, New Jersey | Calif. Spray-Chemical Corp. |
| Farrell, Thomas A. | Ambler, Penn. | American Chemical Paint Co. |
| Feigin, A. O. | N. Y., N. Y. | General Chemical Co. |
| Finch, E. B. | Kansas City, Missouri | Thompson-Hayward Chem. Co. |
| Fitzgerald, Tom | N. Y., N. Y. | U. S. Rubber Company |
| Fleetwood, J. Ross | Columbia, Missouri | University of Missouri |
| Fox, Kirk | Des Moines, Iowa | Meredith Publishing Co. |
| Frankenfield | Des Moines, Iowa | Thompson-Hayward Chem. Co. |
| Frankton, C. | Div. Botany & Plant | Ottawa, Canada |
| Fraser, D. D. | Winnipeg, Canada | Naugatuck Chemicals |
| Fulton, H. C. | Hoboken, N. J. | Standard Agriculture Chem. |
| Fuxa, Ray | Omaha, Nebraska | Miller Chemical Co. |
| Garvin, Jack | Winnipeg, Canada | Canadian Industries Limited |
| Gaskill, H. L. | Omaha, Nebraska | McKesson Robbins |
| Gearhart, R. J. | Philadelphia, Penn. | Pa. Salt Company |
| Gentry, Stanley | Kansas City, Mo. | Evans Orchard Supply Co. |
| Geouringa, L. J. | Wellsburg, Iowa | Grundy County Weed Supt. |
| Gibbo, A. P. | Los Angeles, Calif. | Essick Manufacturing Co. |
| Girardot, Wayne B. | Lincoln, Nebraska | Agrifirst Chemical Corp. |
| Greaney, F. J. | Winnipeg, Manitoba Canada | Line Elevators Farm Service |
| Gremmels, Fred W. | Oelwein, Iowa | Fayette County Weed Supt. |

| Name | Address | Representing |
|---|---|---|
| Grigsby , B. H. | East Lansing, Michigan | Michigan State College |
| Gunderson, A. J. | Cleveland, Ohio | Sherwin-Williams Co. |
| Guy, H. G. | Pittsburgh, Penn. | Koppers Co., Inc. |
| Haffner, Owen H. | Madison, Wisconsin | Wisconsin Coop. Farm Supply |
| Hagen, A. I. | Humboldt, Iowa | Extension Service |
| Hall, William F. | Bound Brook, N. J. | Chipman Chemical Co. |
| Hanson, Howard | Beloit, Wisconsin | Howard Hanson & Company |
| Hanson, Noel S. | Lincoln, Nebraska | University of Nebraska |
| Hardy, Wm. F. | St. Louis 8, Mo. | Dow Chemical Company |
| Hartmann, Theo. | Plainfield, Iowa | Bremer Co. Weed Supt. |
| Haskett, Philip R. | Chicago, Illinois | Dow Chemical Company |
| Haystead, Ladd | New York, N. Y. | Time, Incorporated |
| Helgeson, E. A. | Fargo, North Dakota | N. D. Experiment Station |
| Henke, Frederick G. | Charles City, Iowa | Floyd Co. Weed Supt. |
| Hess, A. D. | Wilson Dam, Alabama | Tennessee Valley Authority |
| Heusel, Logan H. | Kearney, Nebraska | Buffalo Co. Weed District |
| Hinds, R. S. | Winona, Minnesota | McConnon & Company |
| Hoffmann, Otto L. | Naugatuck, Conn. | U. S. Rubber Company |
| Hohn, Robert D. | Saranac, Michigan | Universal Metal Products |
| Hopkins, J. D. | Chicago, Illinois | Albert Dickinson Company |
| Howland, Dr. Joseph E. | Des Moines, Iowa | Better Homes & Gardens |
| Howard, Rufus M. | Lincoln, Nebraska | |
| Hughes, Charles E. | Des Moines, Iowa | Successful Farming |
| Huling, Floyd D. | Fort Dodge, Iowa | County Extension Director |
| Hunter, Clarence D. | Hudson, Michigan | Hardie Manufacturing Co. |
| Huntley, C. W. | Iowa Soil Conservation | Chariton, Iowa |
| Hutchison, J. L. | Topeka, Kansas | Kansas State Board of Agr. |
| Hyland, J. A. | Chicago, Illinois | Pacific Coast Borax Co. |
| Jensen, L. A. | Fargo, N. D. | State College Station |
| Johnson, C. J. | Kansas City, Missouri | California Spray Chem. Co. |
| Jones, Franklin D. | Ambler, Pa. | American Chemical & Paint Co. |
| Jordan, R. M. | St. Paul, Minnesota | Lyon Chemicals, Inc. |
| Kahley, C. L. | Omaha, Nebraska | Miller Chemical Co. |
| Kern, William M. | Toronto, Canada | Electric Reduction Sales Co. |
| Keller, Frank | Minneapolis, Minnesota | Twin City Seed Co. |
| Kelly, Paul H. | Detroit, Michigan | Acme Whitelead & Colie Wks. |
| Keltner, Chas. H. | Springfield, Illinois | Supt. Plant Industry |
| Kephart, L. W. | Beltsville, Maryland | U. S. Dept. of Agriculture |
| Kinch, R. C. | Lincoln, Nebraska | State Dept. of Agriculture |
| King, Kenneth E. | Ames, Iowa | Soil Conservation Service |
| Klatt, W. L. | Lincoln, Nebraska | Dept. of Agr. & Inspection |
| Kline, . J. | Omaha, Nebraska | Fuchs Manufacturing Co. |
| Knowles, Geo. | Ottawa, Canada | Experimental Farm |
| Koehler, E. A. | Rockford, Iowa | County Supervisor |
| Kornberg, Howard G. | Fargo, North Dakota | Fargo Foundry Co. |
| Krausche, Kenneth K. | Philadelphia, Pa. | Penn Salt Manufacturing Co. |
| Krusemark, C. W. | Minneapolis, Minnesota | Twin City Seed Co. |

| Name | Address | Representing |
|---|---|---|
| Kuemmin, A. B. | Detroit, Michigan | Acme White Lead & Color Wks. |
| Laird, Leon H. | Sioux Center, Iowa | Voc. Agr. Instructor |
| Lambert, Willard L. | Des Moines, Iowa | Corn States Hybrid Serv. |
| Langer, Ken | Des Moines, Iowa | Iowa Farm Bureau |
| LaPine, Lewis J. | Chicago, Illinois | Albert Dickinson Co. |
| Larson, Alvin H. | St. Paul, Minnesota | Univ. of Minnesota |
| Latham, Floyd | Grinnell, Iowa | Ahrens Hybrid Corn Co. |
| Lee, Oliver C. | Lafayette, Indiana | Purdue University |
| Lehman, W. M. | Kansas City, Missouri | Sherwin-Williams |
| Leonard, O. A. | State College, Mississippi | Mississippi Exp. Station |
| Levin, I. | Des Moines, Iowa | Iowa Dept. of Agriculture |
| Lewis, David P. | Chicago, Illinois | H. D. Hudson Mfg. Company |
| Longcoy, Olin M. | Orlando, Florida | Aerial Insecticiding, Inc. |
| Loomis, W. E. | Ames, Iowa | Iowa State College |
| Lunz, Henry | Madison, Wisconsin | State Dept. of Agriculture |
| MacDonald, W. P. | Minneapolis, Minn. | F. H. Peavey & Company |
| MacLean, William M. | Montreal, Canada | Dominion Rubber Co. Ltd. |
| Magner, J. Marshall | St. Louis, Mo. | Monsanto Chemical Co. |
| Mahler, Fred W. | Des Plaines, Illinois | Ruptured Duck Farms |
| Mann, Jesse R. | Ackley, Iowa | Mann's Power Spray Service |
| Mann, Joe L. | Ackley, Iowa | Hardin Co. Weed Supervisor |
| Manske, Richard H. | Quelph, Ontario, Can. | Dominion Rubber Co. Ltd. |
| Martin, Chas. A. | Des Moines, Iowa | Chas. A. Martin Co. |
| Mather, W. J. | Edmonton, Alta, Can. | Alta Dept. of Agriculture |
| McCall, G. L. | Wilmington, Delaware | Du Pont |
| McIntyre, C. N. | Columbus, Ohio | Ohio Dept. of Agriculture |
| McLean, L. C. | Sibley, Iowa | Hewlett Farm Mfc. Service |
| Meadows, C. M. | Cleveland, Ohio | Sherwin-Williams Co. |
| Melander, L. W. | Minneapolis, Minn. | U. S. Dept. of Agriculture |
| Merrich, F. L. | Rockford, Iowa | County Supervisor |
| Minner, Al | Sioux Falls, S. D. | Batcheller's |
| Minarik, Charles E. | Camp Detrick, Maryland | War Department |
| Morris, D. B. | St. Paul, Minn. | Lyon Chemicals, Inc. |
| Morris, Robert E. | Waterloo, Iowa | Sherwin-Williams Co. |
| Morrison, Charles S. | Moline, Illinois | Deere & Company |
| Moyer, Wm. O. | Midland, Michigan | Dow Chemical Company |
| Mullison, W. R. | Midland, Michigan | Dow Chemical Company |
| Nelson, C. E. (Jr.) | St. Louis, Mo. | Du Pont Company |
| Nelson, P. A. | Kansas City, Mo. | American Cyanamid Co. |
| Nichols, H. M. | Webster City, Iowa | Nat'l. Ass'n. County Agr. |
| Noe, Warden L. | Topeka, Kansas | Board of Agriculture |
| Nolan, Kenneth G. | Stamford, Conn. | American Cyanamid Company |
| Nord, L. A. | St. Paul, Minnesota | Associated Producers, Inc. |
| Oberhauser, S. J. | Minneapolis, Minnesota | Milwaukee Railroad |
| Ohrt, Lloyd H. | Reinbeck, Iowa | Grundy County Weed Supt. |
| Orr, S. D. | Chicago, Illinois | Swift and Company |

| Name | Address | Representing |
|---|---|---|
| Otis, Chester E. | Seattle, Washington | Dow Chemical Company |
| Parks, Lloyd E. | Chicago, Illinois | Sharples Chemicals, Inc |
| Pass, Herbert J. | Montreal, Canada | Sherwin-Williams Co. |
| Patterson, Norman G. | Brookings, South Dakota | S. D. State College |
| Pavlychenko, T. K. | Saskatoon, Saskatchewan Canada | University of Saskatchewan |
| Perkins, C. W. | Sergeant Bluffs, Iowa | Woodbury Co. Weed Supt. |
| Pielstick, Weston R. | Gering, Nebraska | Scotts Bluff Co. Weed Dis. |
| Piesbergen, N. | St Louis, Missouri | Monsanto Chemical Co. |
| Randall, James F. | Pierre, South Dakota | U. S. Dept. of Agr. |
| Rappe, E. H. | Chicago 9, Illinois | Swift & Co. Plant Food Div. |
| Rasmussen, Lowell | Ames, Iowa | Iowa State College |
| Raynor, R. N. | San Francisco, Calif | Dow Chemical Company |
| Ravenhorst, George | Olivia, Minnesota | Ravenhorst Brothers |
| Rea, N. F. | Sumner, Wash. | Getzum Products |
| Refshauge, Edward | Cedar Falls, Iowa | County Supervisor |
| Reindl, R.G. | Chicago, Illinois | H. D. Hudson Mfg. Co. |
| Reynolds, R. G. | Omaha, Nebr | Miller Chemical Co. |
| Reynolds, W. R. | Arlington, Virginia | War Department |
| Rinnler, Robert H. | Wilmington, Delaware | E. I. DuPont & DeNemours |
| Roe, Jim | Des Moines, Iowa | Successful Farming |
| Rose, Franklin T. | Topeka, Kansas | State Highway Dept. |
| Roth, S. Y. | Jefferson City, Mo. | Mo. State Dept. of Agr. |
| Ruby, J. L. q | Williams, Iowa | Farm Bureau |
| Ryken, M. J. | Ackley, Iowa | Hardin Co. Weed Supt. |
| Sanders, John L. | Richmond, Calif | Calif. Spray-Chem. Corp. |
| Sanderson, E. G. | Aurora, S. D. | S D State Weed Board |
| Schneider, Deane | Shenandoah, Iowa | Henry Field Seed Co. |
| Schrader, C. H. | St. Paul, Minnesota | Dept. of Agriculture |
| Seidel, John | Scranton, Iowa | Greene Co. Weed Co. |
| Shatwell, Wm. E. | Chicago, Illinois | War Department |
| Shaw, A. D. | Chicago, 7, Illinois | Montgomery & Ward |
| Sherplen, R. V. | Hornorville, Pa. | Gulf Research & Development |
| Sherwood, F. R. | Ambler, Pennsylvania | American Chemical Paint Co. |
| Sherwood, Lloyd V. | Champaign, Illinois | University of Illinois |
| Shisler, E. Paul | Columbus, Ohio | Ohio State Highway Dept. |
| Shreve, C. G. | Orlando, Florida | Aerial Insecticiding Inc. |
| Shaptason, J. B. | New York, N. Y. | John Powell Co., Inc |
| Skelton, L. W. | Ambler Pa. | American Chem. Paint Co. |
| Slough, A. T. | Minneapolis 15, Minn. | F. H. Peavey & Co. |
| Smith, Loys F. | Lincoln, Nebr. | State Dept. of Agr. |
| Northwick, Lawrence | Midland, Michigan | Dow Chemical Company |
| Spry, Clyde | Des Moines, Iowa | Asst. Secretary of Agr. |
| Staadt, Harold F. | Ottawa, Kansas | Kansas State Board of Agr |
| Stahl, Chas. A | Lansing, Michigan | State Dept. of Agr. |
| Stahler, L. M. | Lamberton, Minnesota | Bureau of Plant Industry |
| Stamp, Herman | Ocheyedan, Iowa | Osceola Supervisor |

| Name | Address | Representing |
|---|---|---|
| Staniforth, David W. | Ames, Iowa | Iowa State College |
| Stubbe, Ben | Ackley, Iowa | Hardin County Weed Supt. |
| Sunderland, W. W. | Midland, Michigan | Dow Chemical Company |
| Sutton, Bill | Portland, Oregon | California Spray-Chem. Corp. |
| Sweet, Robert D. | Ithaca, N. Y. | Cornell University |
| Swenson, Bernhard C. | St. Paul, Minnesota | State Dept. of Agriculture |
| Swisher, E. M. | Kansas City, Mo. | Rohm & Haas Company |
| Sylwester, E. P. | Ames, Iowa | Iowa State College |
| Thornton, Bruce J. | Fort Collins, Colorado | Colorado Agr. Expt. Sta. |
| Timmons, F. L. | Beltsville, Maryland | U. S. Dept. of Agriculture |
| Torkelson, O. J. | Fargo, N. D. | Fargo Foundry Company |
| Troup, Ralph G. | Phillipsburg, N. J. | J. T. Baker Chemical Co. |
| Vandenberg, W. F. | West N. Y., N. J. | Aeroil Products Company |
| Viehmeyer, Glenn | North Platte, Nebraska | University of Nebr. Sub-Sta. |
| Vodrey, F. C. | Winnipeg, Canada | National Grain Company |
| Walling, R. H. | Omaha, Nebraska | Fuchs Machinery & Supply Co. |
| Warren, G. F. | Madison, Wisconsin | University of Wisconsin |
| Welch, W. L. | Knoxville, Iowa | |
| Wenger, Otto E. | Kansas City, Mo. | Sherwin-Williams Co. |
| Wienh, LeRoy | Sioux Falls, S. D. | Batcheller's |
| Wierama, J. W. | Grundy Center, Iowa | Highway Department |
| Willard, C. J. | Columbus 10, Ohio | Ohio State University |
| Williams, D. A. | Grand Forks, N. D. | Agricultural Supply Co. |
| Winters, Frank T.(Jr.) | Chicago, Illinois | Pacific Coast Boras Company |
| Witman, E. D. | Columbus, Ohio | Ohio State University |
| Wolf, Dr. Benjamin | Bridgeton,N.J. | Seabrook Farms Co. |
| Wolf, Dale E. | New Brunswick, N. J. | New J. Agriculture Expt.Sta. |
| Wollam, L. A. | Minneapolis, Minn. | International Elevator Co. |
| Wood, H. E. | Winnipeg, Manitoba,Can. | Manitoba Dept. of Agr. |
| Woodroffe, Fleeta | Des Moines, Iowa | Better Homes & Gardens |
| Worzella, W. W. | Brookings, S. D. | S. D. State College |
| Yoder, R. M. | Elkhart, Indiana | Dobbins Mfg. Co. |
| Yost, T. F. | Topeka, Kansas | State Weed Supervisor |
| Zahnley, J. W. | Manhattan, Kansas | State College of Kansas |
| Zorsch, Charles P. | Hoboken, N. J. | Standard Agr. Chem. Inc. |

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President Yost. Gentlemen, you will notice the next number on our program is the report on Constitutions and By-Laws by Cliff Schrader, Mr. Schrader.

## CONSTITUTION OF NORTH CENTRAL WEED CONTROL CONFERENCE

### Preamble

This conference is established to bring together representatives of the North Central States of the United States, and other states and areas, and agencies, institutions and persons who are directly interested in or engaged in weed control through research, education, regulation, and merchandising. The purpose is to exchange ideas, experiences, opinions and information, and discuss and plan means of securing more adequate weed control through more and better correlated and coordinated effort on weed research and control by Federal, Provincial, State, local public and private agencies.

### Article I. Name

The name of this organization shall be the NORTH CENTRAL WEED CONTROL CONFERENCE.

### Article II. Membership & Dues

Section 1. Membership shall be of three (3) kinds: active, associate, and honorary. All memberships shall be for the calendar year for which the fees are paid and shall become effective upon the payment of the fees.

Section 2. Active membership shall consist of representatives of the State Department of Agriculture, State Agricultural Experiment Station, and State Agricultural Extension Service and such other groups as may be approved by the heads of the above departments of the thirteen North Central states, Illinois Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio, Oklahoma, North Dakota, South Dakota and Wisconsin of the United States as charter members and such other states, Dominion Government, and provinces of Canada as may be admitted to membership. The annual dues shall be $15 per state, Dominion Government or province of Canada payable at the beginning of the calendar year. Registration fee for active members shall be fixed by the by-laws.*

Section 3. Associated memberships shall consist of other than active and honorary memberships. Annual dues shall be $10 per person per year and shall be paid as a registration fee at the time of the annual meeting.

Section 4. Honorary memberships may be conferred on persons of distinction by the Board of Directors and there shall be no dues.

### Article III. Government & Voting

Section 1. Directors to govern. The government of this conference shall be vested in a board of directors which shall consist of the officers and directors for each state or province for which the membership dues have been paid.

Section 2. Selection of Directors. One director shall be selected annually prior to the conslusion of the annual meeting of the conference by each state, Dominion Government or Provinces of Canada.

*Federal employees shall be considered active members in the state in which they work.

Section 3. A Majority vote is required in all cases except as otherwise provided. Voting by directorship shall be recorded by the Secretary.

Section 4. Voting between meetings of the directors may be conducted by the executive committee by mailing ballots to all directors and notifying them of the purpose of the vote.

## Article IV.

Section 1. The officers of this conference shall be the President, Vice-President, Secretary-Treasurer elected from the active membership. The term of office shall be one year.

Section 2. Executive Committee. The President, immediate past President, Vice President, and Secretary-Treasurer and three members elected from the active membership at large shall constitute the Executive Committee for transaction of routine business between meetings of the directors. They shall be elected annually and hold office for one year or until their successors have been elected and qualified.

Section 3. Duly elected officers and members of the Executive Committee automatically become ex-officio members of the board of directors. The President shall act as chairman of the board.

## Article V. Meetings

Section 1. At each annual meeting of the place for the next annual meeting shall be determined by the directors at a time to be decided by the Executive Committee and the director for the State or Province where the meeting is to be held.

Section 2. Registrants other than directors of the Conference shall have all privileges except voting.

## Article VI. Quorum

Section 1. Two-thirds of the board of directors shall constitute a quorum for transaction of business at any meetings.

Section 2. When voting is by mail, ballots shall be sent to all directors, two-thirds of whom voting shall constitute a quorum.

## Article VII. Rules of Order

Roberts' Rules of Order shall govern the conduct of all meetings

## Article VIII. Amendments

The constitution or the by-laws may be amended by two-thirds vote of the board of directors at any annual meeting provided previous notice in writing has been given to the directors of the proposed amendments at least thirty days prior to the date of vote.

I hereby certify that the foregoing constitution and by-laws was adopted by the directors of the conference at a duly held meeting at Des Moines, Iowa on the 13th day of December, 1946, at which time the following states were active members: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, and Wisconsin.

Signed-- A. H. Larson,
SECRETARY TREASURER

President Yost. Thank you Cliff Schrader. Now I take pleasure in presenting to you Walter Ball of California representing the Western Weed Conference. I am very glad he could attend this meeting and give us his report of the Western Conference and seed work in the State of California, Mr. Ball.

REPORT OF THE DELEGATE OF THE WESTERN WEED CONTROL CONFERENCE
Mr. Walter Ball

It gives me a great deal of pleasure to again be the official delegate of the Western Weed Control Conference to attend your meeting, and please accept my thanks for your kind invitation.

Your Conference has been in existance three years, and I believe I have had the pleasure of attending all of your meetings and, therefore, feel I am more or less of a member rather than a delegate.

Our organization, although going into its ninth year, started as a very small group and has grown slowly until the last two conferences, at which time the attendance increased a great deal. The increase and interest in attendance denotes only one thing and that is, that the interest in weed control is growing by leaps and bounds and that more people are recognizing more than ever the over-all loss by weeds to the nation.

It would be of interest to know how much greater this over-all yield might have been had it not been for losses due to weeds, which include the recleaning of seeds and the dockage of many agricultural commodities and the annual losses due to poisonous plants. I feel quite sure that if it was at all possible to collect this data, the grand total would be almost unbelievable; for that reason those of us in the Western Weed Control Conference feel the need of further and continued effort through all agencies to consider the importance of several factors:

1. Education. Education is not keeping abreast of the weed control problems. Research plus the active interest on the part of commercial chemical interests have introduced materials for chemical weed control so rapidly that results in the field have in instances been more detrimental than beneficial, primarily because education has not developed and has not been given the attention necessary to aid the farmer as well as other operators in this field.

Extension courses should be set up for adult education in rural areas. Disorganized education along these lines has indicated that if properly organized good results could be obtained.

More weed courses in high school agricultural courses would prove most valuable. Much time is spent in these courses on livestock and crop production with little if any mention given to poisonous plants, the introduction of weeds through dirty crop seed, or organized weed control This should be encouraged through the various State Departments of Education.

With the rapid expansion of interest and activity on the part of the farmer and the general public, trained men will be needed in this field to properly organize programs and assist interested individuals, organized groups, highways, railroads and public utilities in weed control problems

The University of California, College of Agriculture added two years ago a degree course in weed control to their curriculum, very few if any agricultural colleges are specializing or offering a course for the purpose of specializing in the training of young men for this field of pest control, although all agricultural colleges offer courses in pathology and entomology.

This phase of education is badly needed which is evidenced by the many requests we receive from all over the nation for men trained or experienced in weed control.

Bulletins, leaflets, and mimeograph material having to do with the field problems for field men and farms are of value. Pictorial information published as a series has proved very helpful.

Mimeographed articles which can be revised and kept up to date, is a form of information which is of importance to field men and to agriculture in general. The Nebraska Department of Agriculture has been outstanding in this form of information.

2. Research Research in the field of weed control is of greater importance today than it ever has been. The introduction of organic chemicals as herbicides has introduced many complex problems The introduction of these materials such as the growth-regulating substances 2-4D and many derivatives, has so far proved to be the most promising phase of chemical weed control yet found. Doctor Krause of the University of Chicago stated at the North Central States Weed Control Conference, held in St. Paul last November, that there are possibly a hundred different possibilities in the use of these growth regulating substances for weeds control through various organic combinations. It can readily be realized the problem that confronts research throughout the country. Without research and field test and with the industry introducing these new materials without adequate tests, the users of these weed control herbicides are going to experience difficulties that will prove costly

The experiment stations generally are understaffed for two reasons. (1) The funds allocated for weed control research are inadequate. (2) Due to this first fact chemical companies have offered greater inducement for some of the best research workers to enter commercial fields. The general public may continue to get the benefits of the results of commercial research continued by these men but too often this information is withheld for competitive purposes. Funds should be made available to experiment stations for expansion and for the purpose of retaining well-trained research men so that the results of the work of these men may be used for the benefit of the general public throughout the nation

3. Regulation. As the educational and research programs develop, regulations will be more workable and enforcible. Organized weed control districts will be requested as better methods are developed Legislation will possibly be introduced incorporating regulated weed control procedure.

It has been noted when attending meetings of the Western Weed Control Conference and the North Central States Weed Conference that when laws pertaining to weed control and seed inspection were discussed many sound ideas were presented. Many states reported that some of the ideas had been enacted into their laws but when the subject of enforcement was discussed few states had adequate manpower or funds for the enforcement of what appeared to be sound legislation.

4. It has been suggested by the Western and North Central Weed Conferences that weeds and weed control be given more consideration by our United States Department of Agriculture inasmuch as the work of the department should be established as a division or bureau as is Entomology and Plant Quarantine. The weed work now is carried on in a limited way in several federal bureaus. All work separately and not in a coordinated manner. The states do not have the opportunity under the disorganized arrangement to work as closely with the U S. Department of Agriculture as they should. Much federal weed control work is done through the Bureau of Reclamation, Department of the Interior. However, this work is confined to the Reclamation Regions.

5. The Western Weed Control Conference is particularly interested in stimulating more interest on the part of those national agencies who have control of Government owned or Government controlled lands. These areas, especially in the western states, are infested with serious weed pests and often are the source of infestations on agricultural areas.

It appears that weeds are not considered of sufficient importance to justify the allocation of funds in the Federal budgets for the control of weeds on such areas. This has been the explanation of officials of the National Forest, National Parks, Indian Service, and other agencies having control of such lands

The Western Weed Control Conference as well as the North Central Weed Conference comprising a total of 24 states, agree that these various Federal agencies should take a greater interest in cooperating with State weed control programs by providing adequate funds for such work.

6. A great deal can be accomplished by urging close cooperation by all agencies in the field of weed control. The workers in the field of education, experimentation and regulation can be of much assistance to each other through close coordination of each other's work--it is all closely related.

I feel quite certain that the North Central Weed Control Conference is generally in accord with these several points, and I know of no other organization in a better position to encourage a greater effort on the part of all the agencies than the combined conferences, which represent some twenty-four states.

Too few people recognize the importance of organized weed control, and too few people realize the ramifications of such a program Those workers in the field in many cases can encourage and do encourage the use of a recognized herbicide for weed control and in a few cases have been able to eradicate the weed pest, helping the farmer a great deal, only to come back in the spring and find that this same farmer who has spent a great deal of money to eradicate a serious noxious weed, planting this same area with seed infested with the seed of that same weed pest, or another to which he has given very little consideration.

The same can be true in the case of fertilizers, mulches, and other agricultural materials used in certain of the agricultural practices, all of these commodities being infested with weed seed.

I believe that many of us agree that more attention should be given to general farm sanitation, which includes the elimination of weeds along fence rows, ditch banks, roadways, and around buildings. This does not only eliminate the spread of many of our weeds, with which we are all thoroughly familiar, but has a very important place in this over-all picture of pest control, in that these more or less non-important weeds or waste-place weeds, as we generally know them, harbor injurious insect pests as well as plant disease organisms which may be carried by these insect pests. I feel quite certain that before many years we are going to be called upon more and more for assistance in the control of those weeds harboring and responsible for insect pests and plant disease losses.

The Western Weed Control Conference, as well as yours, has given a great deal of attention to 2-4D. We have felt that it was necessary to do this for this herbicide has a most important place in the weed control program, but on the other hand we should not forget the fact that there are other important phases of weed control that should not be overlooked. I believe that the subjects already suggested for our next Western Weed Control Conference are going

to cover the field quite generally, although two days will not permit sufficient time to thoroughly discuss the many phases of weed control which have their place in the over-all program. There has been a demand, of course, for definite recommendations for the use of 2-4D, and at our last meeting, which was held in Reno Nevada, our research committee was asked to make a report, and if possible, to make recommendations.

Report of the Research Committee Relative to the Use of 2-4D - Mr. W A. Harvey, Chairman, Experiment Station, University of California, Davis, Calif.:

"The committee would like to emphasize the need for further coordination of the research programs of the various State, Federal, and commercial agencies. It is felt that a greater interchange of information between agencies as well as some specialization by certain agencies would be highly desirable. Thus an organization with a field force working over a considerable territory would be adapted to obtaining information on a wide range of species and environmental responses. Other groups are better equipped to handle greenhouse or laboratory studies and could concentrate on the more fundamental problems including translocations, relation of chemical structure to toxicity, soil factors, etc. These recommendations are not intended to limit the research activities of any group but rather to increase these activities in the fields where a particular group is best qualified to obtain information.

The committee would like to emphasize that the present information on 2-4D is incomplete and that much of the work is preliminary. Thus the recommendations given herein are tentative and should be considered subject to revision as our information and knowledge increases. It would be well to consult local agencies such as Farm Advisors, County Agents, Agricultural Com missioners, Experiment Station workers or Extension Services who may have definite and more specific information for local conditions

The following is recommended as a general guide for testing 2 4D but should not be considered as supplanting available local information.

1 Established grass lawns, turfs, grass pastures, and grass seed fields - 1½ pounds 2-4D acid or equivalent per acre in 100 to 200 gallons of water. At the seedling stage use no more than 3/4 pound 2-4D acid or equivalent per acre.

2. For the control of young broad-leaved annual weeds in corn, barley, and wheat - 1/2 to 3/4 pound 2-4D acid or equivalent per acre in 100 gallons of water.

3. For the control of the listed susceptible weeds, with the expectation of some regrowth occurring in the case of creeping perennials - 1½ to 3½ pounds of 2-4D acid or equivalent per acre in sufficient water to give coverage.

4. For the prevention of seed formation by weeds with properly timed applications of 1½ to 3½ pounds of 2-4D acid or equivalent per acre in sufficient water to give coverage

Note: Proper conditions for the application of 2 4D as a spray are considered to exist at a time when the weeds are in a state of active, vegetative growth.

Below are given the acid equivalent factors, multiply the factor by the number of pounds of the chemical to get the acid equivalent. For example, the sodium salt has an acid equivalent factor of 0.91. One pound of sodium salt is then equivalent to 1 x 0.91 = 0.91 lbs. of 2-4D acid. One pound of a material containing 60 per cent of the sodium salt is equivalent to .60 x 1 x 0.91 = 0.546 pounds of 2-4D acid. These factors can only be used for weights. For liquid preparations it is necessary to know the weight per gallon. For a liquid material containing 20 per cent methyl ester and weighing 8 pounds per gallon, one gallon is equivalent to .20 x 8 x 0.94 = 1.504 pounds of 2-4D acid.

| Compound | Acid Equivalent Factor |
|---|---|
| 2-4D Acid | 1.00 |
| Sodium Salt | .91 |
| Ammonium Salt | .93 |
| Triethanolamine Salt | .60 |
| Methyl Ester | .94 |
| Ethyl Ester | .89 |
| Iso-propyl Ester | .84 |
| Butyl Ester | .80 |

It should perhaps be pointed out that these are chemical equivalent factors. Some products may be more or less active, as far as weed killing is concerned than the chemical equivalent would indicate. However, until definite information is available, it would be best to make comparisons on chemically equivalent amounts. Likewise, two products containing the same equivalent of acid may give different results on weeds because of differences in amount or composition of wetting agents or emulsifying agents which they contain."

The committee submitted three lists of weeds those which had proven susceptible; those which they considered intermediate, and a list of those considered resistant. I am not including these in this report, but they would be available for any one who is interested.

The meeting which was held in Reno last February was a most interesting one, although we had a very difficult problem of housing. The Committee on Arrangements felt that arrangements should be made for possibly fifty or sixty, which was more or less in line with the meetings we had had prior to this and, of course, during the war period it was not anticipated that we would have very many in attendance, but this proved not the case. After we had arranged for some fifty or sixty delegates, 168 reported, and every meeting was well attended.

The meeting started with reports of the state delegates, which has been a subject of some discussion in our conference as to whether or not we should take the time for such reports, inasmuch as there had seemed to be a great deal of repetition. Last year however, we felt that it was quite successful due to the fact that each delegate was requested to discuss only that phase of

weed control in his state that to him seemed outstanding and possibly different from that of some other state. We did receive some repetition, of course, on the use of 2-4D, but a great deal was gotten out of these reports.

Panel discussions were given a great deal of time on such topics as 2-4D, contact and selective sprays, and a very interesting panel on poisonous plants. Due to the fact that in the eleven western states the sheep and cattle industries are of major importance, therefore, poisonous plants on the many thousands of acres of range lands are of major importance.

I would like to mention briefly the meeting of the Western State Seed Officials, that is held annually and at the same time of the Western Weed Control Conference either preceding or following. These officials through their interest in seed inspection and enforcement work have a very important part in this extensive weed control program. Weed seed planted with crop seed has been responsible for the establishment of noxious weeds that has taken years of hard work and money to control and eradicate. These officials stand for quality and purity in crop seed which has a direct effect in reducing the introduction of weeds through crop seed. These men other than those that are also weed officials, attend our weed conference and from our discussion and their contacts with weed officials, they get the true significance of the weed problem and the part they have to play we think is very important.

We appreciated your Mr. Ted Yost being with us as an official representative and giving us the fine report which he did of your last conference. Mr. Timmons also was on our program and gave us a very fine report of your research committee work.

In closing, I bring greetings from the Western Weed Control Conference and invite each of you to attend our next conference, which is being held the sixth and seventh of February, 1947, at the Multnomah Hotel, Portland Oregon.

President Yost. Walter has given us a very fine paper with alot of food for thought in it. We all appreciated it very much. The next number will be "Weed Control Week" by Noel Hanson. Mr. Hanson.

## WEED CONTROL WEEK

After reading Jeff McDermid's article on "Cluttered Calendars" in the November issue of Better Crops with Plant Food published by the American Potash Institute, I hesitate to even begin this discussion entitled "Weed Control Week" However, as I turn my thoughts to the staggering losses that occur annually as a result of weeds and the necessity for public consciousness toward the control and eradication of them, I take heart to proceed.

As the title of this talk implies, I am here to try to point out the need for some sort of campaign to bring about public consciousness in dealing with weed problems. I am suggesting that this conference is in a logical position to take the lead in promoting a campaign that will cover the region of the conference and if enough sentiment is shown in favor of the plan, perhaps it can become nationwide in scope.

I do not believe that it is necessary for me to spend time here in pointing out to you the many losses that occur not only to agriculture, but to industry as well and to the health of the nation from the great list of undesirable plant species known commonly as weeds. You folks are well aware of the situation that exists because that is why you are here.

I propose for your consideration the following plan for a campaign to be conducted in 1947 known as "Weed Control Week". I fully realize that the calendar is becoming "cluttered", as McDermid states, with various types of campaigns which vary from some that have great merit such as "Fire Prevention Week", sponsored by the National Board of Fire Underwriters, to some of much less merit. The "Fire Prevention Week" campaign does not strive toward fire prevention during only one week in the year, but through the publicity that is put behind it in building up to the week, public consciousness is built up to the need for extreme carefulness with fire at all times. There is, of course, no way of even estimating how many fires are prevented or how many lives are saved through such a campaign But even if only one fire of the catastrophic nature of what happened at Chicago last spring and at Atlanta, Georgia, last week were prevented by such a campaign it would be more than worthwhile. Well, someone might say we do not have such catastrophes taking place with weeds. That kind of thinking, we all know, is wrong. Every time an infestation of leafy spurge is left to shed its seed on the soil in Canada, Minnesota, or the Dakotas; or the wind carries the seed of Canada thistle to new areas in Iowa, Illinois, Indiana, and Ohio; or new infestations of quackgrass get started in Wisconsin and Michigan; or bindweed infested wheat is hauled from one farm to another and planted in Kansas and Nebraska, I say it is a catastrophe in agriculture In Ross Fleetwood's behalf I might say that when the geese fly over Missouri and land in Oklahoma without grazing off the Johnson grass in Missouri, that might be considered a tragedy.

The success of a campaign such as Fire Prevention Weed or Weed Control Week, I believe is in direct proportion to the effort put behind it. I present this plan not as a member of any Chamber of Commerce, nor even as a member of the National Society of Hay Fever Sufferers, but merely as one who is interested in seeing that we do what we can with what has proven successful to destroy the weeds we now have and to prevent further infestations. This plan was drawn up by a committee appointed by President Yost with Dr. E. D Witman as Chairman, and Mr. F L. Timmons, Dr. Earl Whitford, Mr. C. H. Schrader, Dr. A. L. Bakke, and myself assisting. Your opinions and comments whether for the plan or against will be welcome.

It is proposed then that this campaign be known as "Weed Control Week" or any other name which would be more appropriate. If the campaign becomes national in scope, the committee has suggested the name "National Weed Week" The objective will be to familiarize the public, either regional or national, farmers and urbanites alike, with the economic, aesthetic, patriotic, and health aspects of the weed problem and to urge the destruction of weeds by any approved method before they set and disseminate their seed. In the case of weeds whose

pollen is detrimental to health, they should be destroyed before blossoming. Such consciousness of the weed problem should be brought about through the dissemination of information on the losses from weeds and also the best information available in each state as to approved methods of control and eradication.

Such a program will need both the financial and moral support of a large number of both organized groups and individuals in order to succeed. The support should be solicited of:

1. Professional groups such as
   a. The Weed Control Conferences both in this region and the western conference.
   b. National Scientific Societies of Agronomists, Botanists, Chemists, Ecologists, Entomologists, Floriculturists, Horticulturists, Plant Physiologists, Seed Analysts, and other similar professional groups,
   c. The National Association of Agricultural Directors.

2. Federal, State, and Municipal groups such as
   a. U. S. Department of Agriculture, State Experiment Stations, State Departments of Agriculture, State Extension Service, State Governors, City and village mayors.

3. Trade Associations such as both the International and State Crop Improvement Associations, National and local farm organizations including Farm Bureau, Farmers Union, and the Grange, Livestock Producers Association, and various Associations of Manufacturers.

4. Civic and other miscellaneous organizations both national and local such as Chambers of Commerce, Rotary, Lions, Kiwanis, Associations of City Land Owners, Federation of Womens Clubs, Garden Clubs, City Health Authorities, City Park Managers, and Public Grounds Superintendents.

5. Manufacturers of weed killers, jobbers, distributors, retail outlets, salesmen, and others interested in weed control. Also manufacturers of equipment and seed companies. This covers a large number of groups, but there may be others who can contribute considerable effort to such a campaign

6. I believe that an important part of such a drive would be missed if there were no recognition program as an incentive for youth and adults alike to learn to know the various common weed species in their communities. For this purpose no doubt many educational institutions and groups could do much in furthering this program. The State and County Extension Services, the national and state 4-H club organizations and local 4-H clubs, the schools and churches could assist materially in conducting state and community weed identification achievement recog nition programs. I hesitate to say contest because we would like to see more individuals gain recognition than is usually the case in a contest.

Who should plan and organize a campaign of this sort? It is proposed for your consideration, and again I say that we want your opinions for or against it, that the following organization be set up:

A. A committee be appointed from the attendance at this conference for further studying this program.. This committee would in turn appoint a larger steering committee including representatives from most or all interested groups. From the steering committee would be elected the necessary executive committee It is logical that a full-time executive secretary be hired to handle the current affairs, publicity, and dissemination of information for such a campaign if the funds were available for it. This would be at the discretion of the steering comm committee.

B. Funds for the campaign would be raised by soliciting interested groups.

C. The program in general should be publicized and carried out by all interested groups in proportion to their interest through the medium of radio, news releases, magazine articles, posters, and placards in public places carrying weed identification and control information and in general publicizing the great need for weed control and eradication.

Dr. Witman moved the adoption of the report Schrader seconded. By vote of the conference this report was adopted and was referred back to the committee for further study and organization.

President Yost. We do not have time to discuss this at this time The next number on the program is listed as New Application Methods for New Herbicides by Mr. Lin Harris It has just been reported that Mr. Harris was unable to attend Before we adjourn, I would like to make a few announcements-- Mr. Keltner, would like to meet with the Resolutions Committee, Dr Bakke has already met with the Auditing Committee, and Dr. Willard would like to meet with the committee on Policy on the Use of New Chemicals Now, Dr. Sylwester would like to make an announcement.

Dr. Sylwester. Mr. Spry wants all materials to be in his hands by January 15th. Mr. Spry made arrangements with the weatherman at Ames to please us with a couple more days of fairly good weather and he promised to accomodate us. The exhibitors have gone to quite a bit of expense in arranging these exhibits and Mr. Spry has made arrangements for transportation over to the International Harvester Building so all of you who are interested may go.

President Yost. We will adjourn to the International Harvester Building

(Visit displays and demonstrations of chemicals and equipment at International Harvester Company, 700 E. Court. Dr. E P. Sylwester in charge )

## WEDNESDAY EVENING

Illustrated Talks on Weed Control. Dr. L M. Stahler, Chairman. A series of short talks illustrated by slides by several weed research workers and motion pictures were shown by several manufacturing companies who showed spraying equipment of various types and discriptions and with which special work of weed control could be done.

The slides and moving pictures along with the explanations were very educational.

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## THURSDAY FORENOON SESSION

The Thursday Morning session of the North Central Weed Control Conference was held in the Savery Hotel Thursday, December 12, 1946. The meeting was called to order at 8:30 A. M. by F. L. Timmons

Mr. Timmons: Members and guests of the North Central Weed Control Conference, Dr. F. D. Jones, the chairman of this mornings session, is unfortunately unable to be present at our meetings due to illness. We regret that he could not be with us in our meetings this year. In Dr. Jones's absence, I have been asked to do double duty as chairman and as moderator of the panel discussion on the effect of New Herbicides on weeds. Our discussion this morning and also the first panel discussion this afternoon will be based largely upon summary reports of results from the uniform program of experimentation with 2-4D that has been carried on in the North Central States and Canada in 1945 and 1946. Our revised plan in use this year consists of six uniform experiments designed to provide a regional study of the effects of 2-4D on weeds and crop plants and the various factors that influence those effects. Our Research Committee believes conducting these experiments uniformly and pooling the results from them in regional summaries have many advantages over an equivalent amount of research that might have been conducted independently by the different cooperators under separate plans of experiment.

More than 200 copies of our 1946 Uniform Plan of Experiments were distributed in response to requests from the various states of the U. S., the Provinces of Canada and two or three other countries. Results from one or more of the uniform experiments were reported to our Research Committee from 44 different cooperators or cooperating stations. Results were reported for 127 separate experiments. Thirty-three of these experiments were conducted in Canada, 19 of which were in Manitoba. Among the states, Kansas reported the results from 24 experiments, Nebraska and Ohio 6 each, and the other states smaller numbers. Only Michigan and Missouri of the member states failed to report on any uniform experiments. Results were reported from 7 experiments in Texas which is outside of our North Central Conference.

The responsibilities for summarizing the results from the uniform experiments and reporting upon them were assigned to the different members of the Research Committee individually, partially on the basis of different weeds and partially by different experiments. The reports will be presented in the form of panel discussions in order to provide an opportunity for open discussion. In order that there will be at least an hour available for questions from the floor and general discussion I plan to autocratically limit each discussion leader on this morning's panel to a definite time for the presentation of his summary report. Since most of the fellows are larger than I am, I may not be able to stop them when I bong the bonger. However, in the weed man's vernacular, if the first treatment is not effective we will keep on applying retreatments until we get control.

Our first discussion this morning is on the effects of 2-4D on field bindweed and will be presented by Mr. Noel S. Hanson of the Nebraska Experiment Station who summarized the results from our Uniform Experiments on bindweed.

Uniform Experiments I and IV, The Effect of Time, Concentration, and Rate of Application of Different Types of 2-4D Formulations on Bindweed(Convolculus Arvensis) By N. S Hanson, Dept. of Agronomy University of Nebraska

Twelve cooperators reported results on bindweed under Uniform Experiments I and IV. They are as follows by states:

| | | |
|---|---|---|
| Indiana | Mr. Oliver C. Lee | Purdue University |
| Iowa | Dr. A L. Bakke | Iowa State College |
| Kansas | Mr V. F Bruns | Canton(Kansas) Bindweed Station |
| | Mr. F L. Timmons | U.S.D.A. Hays Experiment Station |
| Manitoba | Dr H. E Wood | Manitoba Dept of Agriculture |
| Minnesota | Dr. L. M. Stahler | U.S D.A Lamberton Bindweed Sta.. |
| Nebraska | Mr N. S Hanson | University of Nebraska |
| Oklahoma | Mr. W. C. Elder | Oklahoma A. & M. College |
| Texas | Mr Charles J. Whitfield | Soil Conservation Service |
| | Mr Hood Wills | County Agent |
| | Mr. Ralph Thomas | County Agent |
| | Mr. John Box | Irrigationist |

Their reports are as follows:

Indiana

Mr. Lee treated bindweed growing on moist level loam soil of high fertility with pH of 7.0 on June 12, 1946 when the plants were in the early bloom stage The plants were 20 inches in length with dense foliage in succulent condition. The temperature at treatment was 74°F with 62% humidity and clear. The first rain of 1 02 inches fell 48 hours after treatment. The Methyl ester (Dow G652) was applied at 500, 1000, 1500 and 2000 ppm The sodium salt (2,4-Dow) at 1500, ethyl ester (Weedone) at 1500 and triethanolamine salt (Tufor 40) at 1500 ppm. The average survival 120 days after treatment was

15% on Methyl ester 500, 5% on Methyl ester 1000, 5% on Methyl ester 1500, 5% on Methyl ester 2000, 15% on sodium salt 1500, 16% on ethyl ester 1500, and 11% on triethanolamine salt 1500. Some roots killed to 24", others near surface. Several plots sprayed in June 1945 were retreated in June 1946. These show less than 1% survival on October 22, 1946.

Iowa

Dr. Bakke reported data from applications on bindweed treated twice in 1945 on moist level Marshall silt loam soil of high productivity and slightly alkaline. Treatments were made on August 23, 1945, when the bindweed as well developed in late summer and again on September 25, 1945, in the late fall when the bindweed vines were 6 to 12 inches long. All treatments were at 1000 ppm and at 1½ and 1.0 gallons per square rod. No rain fell on the first treatment but 0.10 inch fell 8 hours after the second treatment. Survival notes taken May 7, 1946 were as follows; 0.0 on sodium chlorate, 5 0% on Weedone, 8.2% on Weedicide tablets, 6% on Weedicide liquid, 3 8% on 2-4D, 2.3% on Du-Pont's Ammonium Salt, 4 5% on Chipman Weed Killer, 3.5% on Weedanol. Other products were included which are no longer under development. Dr. Bakke states in his summary, "The data I am sending you is a continuation of those from 1945 where two spray applications were made. The first application in 1946 was on July 17. On August 15 there were plants present and the second spray was made. On October 9, 12 of the 32 plots had bindweed. All plots were sprayed for a third time. Surely with five applications in two years all bindweeds should be killed, but I cannot say definitely until time for regrowth next year."

Canton, Kansas

Mr. Bruns reported on the continuation of two experiments from 1945 and two experiments started in 1946. All treatments to bindweed were made on bindweed growing on upland silty clay loam soil with pH of 5.7 and of medium to low productivity. The soil was Wet to moist at all treatments except at full bloom and summer dormancy in 1946 when the surface soil was dry. Treatments made with the sodium salt (Dow A506) at 1000 ppm. and at 3/4, 1½, and 2¼ gallons per square rod at the full emergence, pre-bud, full bloom and summer dormancy stages in 1945 were repeated in 1946 at the same stages except for summer dormancy. Survival notes taken approximately 90 days following the second treatment show that from 10 to 155 plants remain of an estimated original stand of 800 plants per square rod. The most effective results having been obtained from the use of 1½ gallons per square rod of 1000 ppm of the sodium salt at the rapid growth pre-bud stage where 10 plants remained on each of the two duplicate plots after the two treatments.

In a comparison of the various 2-4D products the 1945 treatments were duplicated in 1946. For comparison here only the average data from 1000 ppm. at 1½ gallons per square rod will be given. The figures are given as averages of duplicate plots in plant survival per square rod approximately 90 days following the second treatment. There are 56 plants on Dow A506 (sodium salt),

103 plants on DuPont No. 1 (ammonium salt), 13 plants on Weedone (ethyl ester) 108 plants on Weedicide tablets, 169 plants on Dow A510 (sodium salt), 95 plants on Chipman 2-4D Weed Killer (Sodium salt). It is assumed that the original stand was approximately 800 plants per square rod originally on these plots before the first treatment.

Data is available next from the time, concentration, and rate study started in 1946. Treatments were made at full emergence on May 18, 1946, at appearance of first bud on May 23, 1946 at full bloom on June 8, 1946, and at summer dormancy on August 9, 1946. Chipman 2-4D Weed Killer and 2-4 Dow were used to represent the sodium salts, Weedanol M 1 was used for the free acid in a carrier Weedone, Dow (G654) and Weed-no-more 40 were used as esters, and 2-4 Dow liquid and Tufor 40 were used for amine salts. All were applied at concentrations of 1000, 1500, and 2000 ppm. at a standard rate of 1½ gallons per square rod. The original stand before treatment varied from 375 plants to 980 plants per square rod. Average survival in plants per square rod from duplicate plots 90 days after treatment were as follows: Full emergence stage: At 1000 ppm. the survival in plants per square rod ranged from 32.5 on Weedone to 76.0 on Chipman 2-4D weed Killer. At 2000 ppm the range was from 39.0 on Tufor 40 to 68.0 on 2-4 Dow liquid.

Appearance of first bud stage: At 1000 ppm the range in plant survival was 15.0 on Weedone to 48.0 on Tufor 40. At 1500 ppm 17.0 on Chipman to 52.5 on Weedanol. At 2000 ppm 11 5 on 2-4 Dow liquid to 62.0 on Dow (G654)

Full bloom stage: At 1000 ppm the range in survival was from 63.0 plants per square rod on Weed-No-More 40 to 254 0 on Chipman 2-4D weed killer. At 1500 ppm from 77.5 on Tufor 40 to 220.5 on Weedanol M 1. At 2000 ppm from 61.0 on 2-4 Dow liquid to 208.5 on Weedone.

Summer Dormancy Stage: At 1000 ppm the range was from 306.5 plants per square rod on Weedanol M1 to 687.5 on Chipman. At 1500 ppm 212.5 on 2-4 Dow Liquid to 787 5 on Weed-No-More 40. At 2000 ppm 255.0 plants on Tufor 40 to 812.5 on Weed-no-more 40.

From these data it is indicated that the best results in 1946 at Canton, Kansas, was from treatments applied when the plants were in the full emergence and rapid growth pre-bud stages of growth when soil moisture was favorable for active growth of the plants The least effective results were from treatments during summer dormancy when both surface and subsoil were dry and the light foliage in a dry condition.

In a comparison of 2-4D commercial products at Canton, Kansas, the applications were made at the rapid growth stage on May 27, 1946, when a few plants were in bloom. All products were applied at 1000 ppm at 1½ gallons per square rod. Average stand counts from 2 plots approximately 90 days following treatment are as follows: Chipman, 58 plants; 2-4 Dow powder, 68; Slayzweed, 82.5; Ded-Weed, 76.5; Bakers, 67.0; DuPont Ammonium Salt, 79.5; Methoxone, 41.0; Weedone, 46.5; Weedanol M 1, 36.0; Carbowax and 2 4D, 36.0; Weed-no-more 40, 37 5; Dow (G654), 32.5; Tufor 40, 42.5; 2,4-Dow liquid, 65.0; Rid-o-weed, 77.5; Purina, 52.0; Dow A-536, 82.5; Dow A506, 86; and Weedicide Tablets, 81.5 .

Hays, Kansas

Mr Timmons reported on two experiments started in 1945 and two started in 1946. The first one started in 1945 was on the effect of applying 2-4D at various stages of development of bindweed. In this experiment only 2-4D in carbowax at 1000 ppm and at 3/4, 1½ and 2¼ gallons per square rod were used. This was applied at six stages of growth on upland and bottomland plots. The results are reported, but as an average of both upland and bottomland plots, as follows: (The data is reported as percent regrowth based on the original stand).

1. Before emergence: Applied March 31, 1945. Approximately 60 days after treatment the percent regrowth was 95, 50, and 78 from 3/4, 1½, and 2¼ gallons respectively. On May 21, 1946 the readings were 50, 39, and 78 per cent respectively. One-half of each plot was retreated August 29, 1945; the readings on these were 29,25, and 51.
2. Complete emergence: Applied April 21, 1945. Approximately 120 days after treatment the regrowth was 23, 29, and 26 per cent respectively from the three rates. On May 21, 1946 the survival was 36, 22, and 20 per cent. On retreated areas they were 18, 19, and 9, showing greater reduction on retreated areas.
3. Pre-bud: Applied May 24, 1945 Approximately 90 days after treatment the percent regrowth was 11, 17 and 17 from the three rates 3/4, 1½, and 2¼ gallons per square rod. In May, 1946, 16, 53, and 39 On retreated areas 15, 19, and 21, showing reduction in favor of retreatment.
4. Full bloom: Applied June 19, 1945. Approximately 90 days following treatment the regrowth was 48, 50, and 59 for the three rates. On May 21, 1946. 57, 61, and 88, and from retreated areas 35, 54, and 45 per cent again in favor of retreatment .
5. Summer dormancy: Applied August 4, 1945. The treatment was applied August 4, 1945, and the regrowth counts taken May 21, 1946. These were 90, 26, and 86 respectively for 3/4, 1½, and 2¼ gallons.
6. Early fall growth: Applied September 15, 1945. This was applied only on upland soil Regrowth counts May 21, 1946 showed an average of 38, 19, and 17 per cent from the three rates.

Timmons states that the greatest reduction in stand of bindweed on upland resulted from spraying at the pre-bud stage and on bottomland from spraying at full emergence. Results of spraying at full bloom were considerably poorer and were very little better than from spraying at pre-emergence and at summer dormancy. Spraying at the pre-bud stage in early fall on September 15 gave a somewhat greater reduction on upland than spraying at the same stage in the spring despite unfavorable conditions of dry soil and sparse weed growth in the fall. There was no consistent advantage for increased rate of application except in the case of the early fall treatments which showed a definite advantage for the heavier rates. The indications were that even under the most favorable conditions several repeated sprayings with 2-4D would be required to complete eradication.

From a comparison of 2,4 D formulations at different concentrations and rates started in the spring of 1945, Timmons states the following: "The kill of bindweed tended to be better on upland than on bottomland replicates. As an average of the two replicates there appears to be no definite or consistent advantage for heavier rates of applying either Dow A506 or 2,4-D in Carbowax. On the other hand heavier concentration of spray appeared to give definitely better results in the case of DuPont IN-6065. DuPont IN-4311-A9 and Weedone tended to give better results than Dow A506 and A510. No advantage for 2000 ppm. Over 1000 ppm. was apparent in the results from 2,4-D in Carbowax, DuPont IN-6065-A7, Chipman 2,4-D, or Weedicide tablets. The results were hardly consistent enough to show differences in the effectiveness of the various 2,4-D formulations. However, the results tended to be better at comparable concentrations and rates of application for Dow A510, DuPont IN60665-A7. Weedicide tablets and Chipman 2,4-D. Poorest results were obtained from 2,4-D in Carbowax and the other three DuPont formulations. Results from Dow A506 and Weedone were intermediate. The most logical conclusion from this experiment, Timmons points out, appears to be that several repeated spray treatments with 2,4-D (more than three) over a period of years (more than two) are necessary to eradicate bindweed. The small increase in reduction of stand from repeated treatments indicates that it may be impossible to accomplish complete eradication of bindweed with 2,4-D alone."

From a similar experiment started in the fall of 1945 the following statements are made: The results with Dow A510, 2,4 D in Carbowax and DuFont No. 1 showed consistently greater reductions in stand from higher concentrations of spray. There appeared to be some advantage for the heavier rate of spray (1½ gallons per square rod) as compared with the lighter rate (3/4 gallon per square rod). The 2,4-D formulations which gave the best results from the original spray at 1000 ppm and 1½ gallons per square rod were Dow A506, Weedone, DuPont No. 3, Dow A514, a.4-D in Carbowax, Sherwin-Williams No. 2 and Dow A510 in that order. Chipman 2,4-D and Weedicide which gave the best results in the experiment started May 24, 1945, gave relatively poor results in this experiment. The reduction in stand of bindweed was significantly less also from Dow 2,4-D dust, DuPont No. 1 Slayzweed, Sherwin-Williams No. 1, Weedanol, and Dow A536.

Uniform Experiment I-2studying the effect of stage of growth, concentration, and rate of application of 2,4-D on bindweed will be considered next. Data is reported for treatment at three stages of growth; full emergence, first bloom, and full bloom.

The 2,4-D Dow powder and Tufor 40 were used at full emergence. These two plus Weedanol M1 and Weed-No-More 40 were used at the first bloom stage. At the full bloom stage 2,4-Dow and Tufor 40 were used. These products were applied at 500,1000 1500, and 2000 ppm. at the standard rate of 1½ gallons per square rod.

The best results shown from regrowth counts 4 months following treatment were obtained from treatments at full emergence and full bloom. With the exception of 2,4-Dow powder at 500 ppm. all regrowth percentages from these two stages are below 10 per cent ranging from 1 per cent to 8 per cent. Regrowth from treatments at the full bloom stage vary from 2 to 20 per cent on 2,4-Dow and from 10 to 15 per cent on Tufor 40. The data shows a definite drop in percentage regrowth from 500 to 1000 ppm. on sodium salt whereas this is not true of the other types. At the first two stages, there was no increase in effectiveness from 1000 ppm. to the higher concentrations. At the full bloom stage the 1500 ppm. was slightly more effective than 1000 ppm. but there was no increase in favor of the 2000 ppm concentration. Timmons points out that a heavy stand of bindweed seedlings were present on these plots in the fall on October 2, 1946.

In a comparison of commercial formulations under Uniform Experiment IV applied June 5, 1946, the following percentages of regrowth were present on September 30, almost 4 months later.

| Formulation | Type | 1st replicate | 2nd replicate |
|---|---|---|---|
| Chipman 2,4-D | Sodium salt | 24 | 5 |
| Weedone | Ethyl ester | 89 | 41 |
| Weed-No More 40 | Butyl ester | 54 | 19 |
| Stantox 2,4-D | Amine salt | 65 | 15 |
| Baker | Sodium salt | 50 | 13 |
| Concentrate No 6 | Amine salt | 71 | 9 |
| 2,4-Dow powder | Sodium salt | 131 | 20 |
| 2,4 Dow liquid | Amine salt | 67 | 9 |
| Weedanol M 1 | Free acid | 95 | 15 |
| Tufor 40 | Amine salt | 72 | 7 |
| DuPont 2,4-D | Ammonium salt | 119 | 25 |
| Weedanol M 1 | Free acid | 84 | 10 |
| Weed-Ded | Amine salt | 14 | 9 |
| Slayzweed | Sodium Salt | 44 | 38 |
| Weedicide Hi Conc. | Amines Salt | 101 | 28 |
| Stantox Powder | Sodium salt | 67 | 21 |
| Weed Tox 40 | Amine salt | 43 | 12 |
| Weedicide powder | Sodium salt | 3 | 1 |
| Weed Tox powder | Sodium salt | 56 | 11 |
| Dr. Salisbury's 2,4-D | Amine salt | 65 | 25 |
| | | | |
| Average Free Acid | | 90 | 13 |
| Average Sodium Salts | | 43 | 15 |
| Average Amine Salts | | 70 | 16 |
| Average Esters | | 72 | 30 |

The per cent regrowth varies on the one replicate from 14 per cent on Weedded (Amine salt) to 131 per cent on 2,4-Dow liquid also and (Amine salt.) On the sescond replicate the range is from 5 per cent on Chipman 2,4-D (sodium salt) to 41 per cent on Weedone (ethyl ester). The average of the various types is in favor of sodium salt very definitely on the first replication and in favor of the free acid only slightly on the second replication.

## Winnipeg, Manitoba

Mr. Wood reported the use of the four types of 2,4-D products: The 2,4-Dow (Sodium salt), Weedanol M 1 (acid, Dow G654 (methyl ester), and Stantox (Amine salt) These were applied at the pre-bud and full bloom stages of growth at 1000 and 2000 ppm. and at 3/8 and 3/4 gallon per square rod. About six weeks after treatment at the pre-bud stage, the poorest results were evident from the free acid at both 1000 and 2000 ppm. Only about 5 per cent re-emergence had taken place on plots of the other three types. The results were less satisfactory from the treatments at full bloom; however, the better results were obtained from the sodium salts, esters, and amines which were about equal.

Mr. Wood states, "In the 1945 trials observed in late spring and early summer kills on plots treated July 12, 1945 generally showed 50 to 75 per cent of the plants killed, whereas plots treated September 14, 1945 at 2000 ppm. gave 100 per cent kills on all but one plot which was 90 per cent."

## Lamberton, Minnesota

Doctor Stahler reported on experiments started July 3 and September 1, 1945 at Lamberton, Minnesota, on Experiments from 9 locations in North Dakota started in August 1945, and experiments from 11 locations in South Dakota started in mid July, 1945. At Lamberton the treatments were made at full bloom on July 3, 1945 and after fall regrowth of bindweed on September 1, 1945. In regard to these experiments Stahler says, "It appears that fall treatments are not as promising as the treatments made at approximately the full bloom stage.. Even so the fall treatments gave us an excellent control in most cases. These plots were retreated in July of 1946 with not too good results apparent this fall." The survival on July 6, 1946 following treatment on July 3, 1945 varied from 2.0 per cent on 2,4-Dow powder at 1500 ppm. to 54.0 per cent on Weedone at 1000 ppm. and both at the standard rate of 1½ gallons per square rod. The survival range on treatments made September 1, 1945 and recorded July 6, 1946 was from 10.0 per cent on Weed-No-More 40 to 29 5 per cent on 2,4-D and Carbowax.

The data from the experiments in North Dakota indicate that where the bindweed was treated in full bloom to late bloom stage in early August, 1945, low percentages of survival were evident both in June and September,1946 were at concentrations of 500 ppm The average for 9 locations was as follows: Sodium salt 500 ppm., 11 5 per cent; 1000 ppm., 10.5 per cent; 1500 ppm., 11.5 per cent. Ammonium salt: 1000 ppm., 9.5 per cent; 1500 ppm. 12.0 per cent. Ester: 12.0 per cent. The ammonium salts and esters were applied in June 1946 so cannot logically be compared with application made in 1945.

The experiments in South Dakota applied at full to late bloom in mid July, 1945 show less effective results than those in North Dakota. The averages of 11 locations are as follows: Sodium salt: 500 ppm., 24.0 per cent survival; 1000 ppm., 18.6 per cent; 1500 ppm., 16.0 per cent. Ammonium salt: 1000 ppm., 19.9 per cent; and 1500 ppm., 16.4 per cent.

Stahler did not include data from 1946 experiments because he believed that the results would be misleading when reported in the same year. He indicates that a complete series of tests are underway at the Scotland, South Dakota station and that these data will be available in 1947.

Lincoln, Nebraska

Data is reported from two experiments at Lincoln. The first having been started in 1945 and the second started in 1946. Seven different 2,4-D chemicals were applied on May 30, 1945 to bindweed in the pre-bud stage of growth. The original stand of plants was 565 per square rod. Dow A510 was used at 500, 1000, and 1500 ppm. The remainder was applied at 1000 ppm. and all were applied at the rates of 3/4, 1½, and 2½ gallons per square rod. Survival stand counts were taken on May 11, 1946. At that time, the range in survival was from 8.0 per cent on Dow A510 at 1000 ppm. and 1½ gallons per square rod to 114.5 per cent on Weedone at 1000 ppm. and 1½ gallons per square rod. These plots were not retreated in 1945 due to lack of sufficient re-emergence to make retreatment worthwhile. During the remainder of the season there were no blossoms or seed produced on plants on the treated plots. In the spring of 1946 the plants that appeared were approximately one week later in emerging than the untreated. However, the plants appeared normal otherwise and blossoms were formed that set normal appearing seed. Blossoming, however, was delayed by about a week to ten days from Normal. The plots were retreated in the fall of 1946.

Another set of plots was treated with 14 different 2,4-D products on September 6, 1946 when the plants were just emerging after summer dormancy. Both surface and subsoil were extremely dry and conditions were generally unfavorable for treatment. The range in percentage survival was from 3.4 per cent on Dow A510 at both 1000 and 1500 ppm and 1½ gallons per square rod on both plots to 94 per cent on 2,4-D in Carbowax at 1500 ppm. and 1½ gallons per square rod.

In uniform experiment I-1 started in 1946, four different chemicals; namely, 2,4-Dow, Weedone Weed-No. More 40, and Tufor 40 were applied at 500, 1000, 1500, and 2000 ppm. and at 1½ gallons per square rod at three different stages of growth; full emergence, first bud and full bloom. The results are as follows and are reported as the average plant survival from two replications:
Full emergence: 120 days after treatment. 2,4-Dow, 5% plants on 500 ppm., 36 on 1000, 3.5 on 1500 and 6 on 2000 ppm. Weedone, 500 ppm., 1.5 plants; 1000 ppm., 1 plant; 1500 ppm., 120 plants; and 2000 ppm. 85. For some reason the 500 and 1000 ppm. gave better results than 1500 and 2000 Weed-No-More 40: 500, no plants; 1000 ppm. 51 plants; 1500 ppm., 67 plants; and 2000 ppm., 56 plants Tufor 40: 500 ppm., 2 plants; 1000 ppm., 71 plants; 1500 ppm., 1.5 plants; and 2000 ppm. 65 plants This great variability was mainly on one replication; the other was consistently low.
First bud stage: 120 days after treatment. In this case the range was from 10.0 plants on 2,4 Dow at 2000 ppm to 47.0 on Weed-No-More 40 at 2000 ppm.
Full bloom: 90 days after treatment Here the range was from 29 plants on 2,4-Dow at 1000 ppm. to 660 on 2000 ppm, on Weed-No More 40. The poorer results in this test was with the highest concentrations of Weed-No-More 40.

It was noticed that the bindweed foliage was killed much more rapidly by both the butyl ester and ethyl ester than by the amine salt or sodium salt This may mean that at the higher concentrations the plants are killed too rapidly to permit the proper penetration of the chemical into the roots. The best results this year were obtained from treatments at full emergence and at the first bud stages Considerably poorer results being obtained from treatment at full bloom. It is pointed out that no blossoms or seed were produced on the plants which re-emerged. In such a case, one treatment per season is sufficient and consecutive treatments should be made in consecutive years.

Stillwater, Oklahoma

Mr Elder reported on Uniform Experiments I and IV started in 1946. Treatments were made at the full emergence and full bud stages of growth on April 16 and May 3, 1946, respectively After 120 days following treatment at full emergence the percentage survival ranged from 26 on 2,4-Dow liquid at 1500 ppm. to 85 on Chipman 2,4-D Weed Killer at 1000 ppm. both 1½ gallons. At 120 days following treatment on May 3, the range was from 3 0 per cent on Weedone at 1000 ppm. and Weed-No More 40 at 2000 ppm. to 5.5 per cent on Chipman at 1000 ppm. and 2,4-Dow liquid. The indication here is that the better results were from the treatment at full bud stage,however, Mr. Elder reports that either a disease or insect killed the vines on the next stage of growth and may also have affected the results here. About Experiment IV Mr Elder states that "We cannot see much difference in the results from the several 2,4-D compounds used or in different concentrations if above 1000 ppm. is used on bindweed. Some react a little more quickly, but the end result is about the same. The proper stage of growth and proper weather conditions seem to play a much more important part in killing bindweed than different types of 2,4-D." The results 120 days after treatment with 14 different products varied from 3.5 to 9 5 per cent.

Perryton, Texas

Mr. Wills reported that bindweed plots with blooms present and about 8 inches long were treated on May 18, 1946 with 18 different products all at 1000 ppm and 1½ gallons per square rod. The stand of plants was 1250 per square rod originally. The percentage reduction in top growth varied from 69 on Concentrate No. 6 to 98 per cent on seven of the products. Weedone dust was used as well with top growth reduction of 40 per cent.

Another set of plots was treated on August 17 The percentage reduction in top growth varied in this case from 70 to 90.

Amarillo, Texas

Mr Whitfield reported the use of 13 products all applied at 2000 ppm. and 1½ gallons per square rod. These were applied at three stages of growth; namely, the rapid growth stage, full bloom, and mature seed stages, on April 10, June 6, and July 29. The survival at the rapid growth stage varied from 8 0 per cent on Tufor 40 to 76 on Karmex the Ammonium salt. At the full bloom stage the survival varied from 16 per cent on Tufor 40 to 51 per cent, on Dow G-562 At the mature seed stage the range was from 6 per cent on Tufor 40 to 75 per cent on Dow G-562. Very little difference in effectiveness between times of application was noted..

Pampa, Texas

Mr. Thomas reported the use of eight different 2,4-D products on bindweed in the partial to full bloom stages from May 24, 1946 to October 24, 1946. These were applied at 1000 1500, and 2000 ppm. Results varied from 0 to 90 per cent survival four to five weeks following treatment. Mr. Thomas says, "In 1946 trials were made with various brands of 2,4-D under different conditions It was another dry year and most of the spraying was done when there was little of either topsoil or subsoil moisture. Very little difference was noticed from the various brands of 2,4-D "

Lubbock, Texas

Mr. Box reported the use of Weedone and Weedex at 1500 and 3000 ppm on bindweed where the stand varied from 175 to 195 plants per square rod before treatment. At 120 days after treatment the stand was 37 and 35 plants per square rod on Weedone, 1500 and 3000 ppm , respectively, and 45 and 43 plants on Weedex, 1500 and 3000 respectively. Mr. Box says, "Extremely adverse climatic conditions made positive results hard to obtain and equally hard to determine once they were obtained."

SUMMARY

1. With the exception of results from Manitoba there were no reports of complete eradication of bindweed even after four treatments.

2. The factor that appeared to influence differential results the most was soil moisture and its effect on the active growth of the plant. There was some exception to this at Hays, Kansas, and Lincoln, Nebraska where good results were obtained in the fall when soil moisture was low and the plant development sparse

3. Temperature, at least under the conditions of these experiments, had little apparent effect in expressing differential results

4. Humidity did not appear to influence results measurably

5. Little, if any, difference was evident between the four different types of 2,4-D except that the top growth still was the most rapid from the esters.

6. Even though small differences did occur between different commercial formulations, it is doubtful that any of the differences can be considered significant.

7. The best results were obtained after the plants were treated during a period of active growth either from full emergence to initiation of blossoming in the spring or after summer dormancy in the fall. Results from treatment during slow growth of mid-summer were very poor.

8. In most cases, the results from 1000 ppm. were as effective or more effective than from higher concentrations. Even though good kills were obtained from 500 ppm. it does not appear logical to use this low a concentration under field operation.

9. It appears at this time that if 2,4-D is to be used on bindweed, it will have to be used as a means of control in the prevention of seed formation and reducing the competitive action of bindweed on some of the tolerant growing crops. Not more than two treatments per year (in most cases only one) appears logical and in some areas it may not be necessary to treat more than once every two years.

Mr Timmons. Thank you Noel. Now, we shall go on to Dr. Bakke's report.

## Leafy Spurge

Leafy spurge received considerable attention from our Canadian workers. Eight different reports, which included provinces of Saskatchewan, Alberta and Manitoba, were submitted. As it is not possible to be present the reports in their entirety, I will attempt to give the important points for each.

Friesen Schanzenfeld School - south of Winkler 30 miles from Winnipeg. Treated May 28, 1946 - half in flower - 18 compounds 2000 ppm. Retreated July 6. None of the plots showed a satisfactory kill - heavy growth September 13.

Chemel - Middlechurch 8 miles from Winnipeg. Sprayed Herbate (Am. salt) Weedone, Dow, Naugatuck May 23, 1945, - prebud. Used solutions 1000 - 4000 ppm. September 28, 1945 - 75 per cent kill of tops. Sprayed September 2, 1945 half of each plot retreated 6-8, 1946 and again on June 19, 1946. Treated with Dow A 510, Weedanol, Carbowax, Du Pont In 6065 July 11, 1946 best results obtained from Herbate In 6065 2000-3000 ppm - 95 per cent.

Middlechurch - spurge 12 inches. Sprayed August 29 - Naugatuck 4000, 6000, 8000, 10000 ppm - 1 gal. per square rod No growth October 5, 1946.

Friesen - Winkler, Canada. August 5, 1946 - 24 inches past seeding stage. Sprayed 3/4 gal. per square rod. Used Herbate (DuPont salt) Weedone, Green Cross (Ester), Dow(Amine) 2000-7000 ppm.-obtained as good results 2000 ppm. as 6000 on September 13. No particular differences -no surviving plants on September 13.

Melita, Manitoba, Canada. Used Weedone, Naugatuck, Dow 654, Dow 510A. From 1945 experiments it was found that 2,4-D was not highly effective in controlling leafy spurge. In 1946 used 2000 ppm 1½ gallons square rod. Full bloom June 25. Well developed July 26 Prefrost - September 28. Sprayed Full bloom, well developed stages Above ground parts treated with Weedone and Dow G654 killed completely, Growth from roots was resumed in 3 weeks. On Naugatuck sprayed plants regrowth was slower; action slow for Dow A510. First spraying killed 90 per cent of top growth; June 25 -- second spraying; the remaining 10 per cent

was killed with the second spray July 26; at time of third spraying plants were 2 inches high - 25 percent of plants were killed Final results 1947.

Dominion Experimental Station, Lacomb Alberta. June 4, 1946 used Dow A510, G650. No significant difference between the two at different concentrations.

Methoxone (2 methyl --4 chloro- phenoxy-acetic acid) Regrowth spindly on all plots. Gave a complete kill

T K Pavlychenko-University of Saskatchewan - Balgonie, Regina, Sask. Used Dow G652, Weedone Naugatuck, Chipman. Sprayed June 1 1946 - 1000 ppm Obtained 100 per cent injury to above ground parts with one, two and three applications. November 2, 1946-most cases 100 percent kill.

Regal Dairy - Winnipeg. Treated June 5, 1946. Sodium salt, Ester (Green Cross), Naugatuck (Amine) - 3/8 - 3/4 gallons per square rod. Surviving September 1, 1946. 20-60 per cent. Treated July 4, 1946 - surviving September 11 2 per cent. Treated August 27 - past seeding - no results obtained.

Hanson, University of Nebraska, Lincoln. 5/18, 1946 - used sodium salt, butyl ester, amine salt of 2,4-D in concentrations of 500, 1000, 1500 ppm. on heavy infestations of leafy spurge in grass sod. Results in 30 and 60 days were poor.

Stahler, Bureau of Plant Industry, Lamberton, Minnesota. Carried on some extensive 2,4-D experiments in South Dakota, Minnesota and North Dakota. As they are typical of the results one can expect with leafy spurge, Stahler's table is reproduced in its original form.

Leafy spurge plants treated August 21, 1945 with Dow sodium salt, DuPont ammonium salt, Sherwin Williams ester and 5 percent sodium salt dust and retreated with the same materials again on June 5, 1946 had a recovery of 71 to 97 percent. The treatments in 1946 were no better. Apparently the tops are killed with concentrations of 1000-2000 ppm. of 2,4-D. The Canadian workers however, report good results when high concentrations are used. Stahler finds that borax or sodium chlorate gives better results. It is probably too much to expect that every pernicious weed can be killed with 2,4-D. It may be that leafy spurge is one of the weeds that is particularly resistant to 2,4-D.

## Leafy Spurge

Effect of borax, chlorate, ammonium and sodium salt of 2,4-D on Leafy Spurge in North Dakota and Minnesota. Cooperative investigations between the Bureau Plant Industry, USDA and the respective Agricultural Experiment Stations.--L. M. Stahler

| Location of trial County | State | Percent survival of leafy spurge one year after application for treatments made in June or early July, 1945, when spurge was in full bloom. | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Borax 15# per sq.rd. | Chlorate 4# per sq. rd. | Sodium salt of 2,4-D 500 ppm | Sodium salt of 2,4-D 1000 ppm. | Sodium salt of 2,4-D 1500 ppm. | Ammonium salt of 2,4-D 1000 ppm. | Ammonium salt of 2,4-D 1500 ppm. |
| Brookings, | S. D. | 3.0 | 28.0 | 89.0 | 90.0 | 88.0 | 86.0 | 88.0 |
| Roberts, | S. D. | 1.0 | 11.0 | 71.0 | 84.0 | 85.0 | 91.0 | 73.0 |
| Ramsey, | N. D. | 0.4 | 1.2 | 73.0 | 89.0 | 91.0 | ---- | ---- |
| Ward, | N. D. | 5.0 | 18.0 | 99.0 | 99.0 | 99.0 | ---- | ---- |
| Ottertail, | Minn. | 0.2 | 2.5 | 88.0 | 93.0 | 84.0 | 88.0 | 79.0 |
| Hennepin, | Minn. | 6.0 | 12.0 | 95.0 | 100.0 | 88.0 | 100.0 | 90.0 |
| Renville, | Minn. | 1.5 | 2.0 | 72.0 | 86.0 | 80.0 | 80.0 | 78.0 |
| Av. all locations | | 2.6 | 10.9 | 82.0 | 90.1 | 86.3 | 85.5 | 81.5 |

Chlorate and borax applied dry.
2,4-D sprays applied at rate of 1½ gallons per square rod.
All treatments applied to replicated plots at each location.
Leafy spurge growing in grass or uncropped land at each location and no area was disturbed after treatment in 1945 and through 1946.
Leafy spurge produced flowers and seed on all 2,4-D treated plots in 1946.

CANADA THISTLE by A. L. Bakke

From our experience with Canada thistle, we know that it is resistant to 2,4-D. All the experiments reported show that it is not possible to kill Canada thistle, no matter what the concentration with only one spray application. The shoots which come in contact with the spray are killed. However new shoots appear from the underground stems and roots. At the time of the second application t there may be in fact more shoots than were present originally. Apparently the diffusion of 2,4-D is effective for the main stems but action does not extend horizontally. However, there is definite reduction in the number of plants. At the Iowa Agricultural Experiment Station, two 2,4-D applications were made in 1945; by 1946 the number of Canada thistle had been reduced approximately 70 per cent. In 1946, the plants were one to two feet shorter than they were the previous year. There was no significan difference in the various formulations of 2,4-D. After two 2,4-D applications in 1946 the number of plants had been materially reduced. The most effective time for application of 2,4-D appears to be at the early bud stage. By an examination of the data, which has been tabulated, from different states, it will be an easy matter to note the results that have been obtained. Since the report of the Wisconsin Station by DR. BUCHHOLTZ is more or less typical of the results one can expect in one year's work from treating Canada thistle with 2,4-D, it is included in its entirety.

**********

| Plot No. | Date and hour of first application | No. of original plants per sq.rd. | Stage of growth Height, density Succulency | Chemical used Rate per sq. rd. Concentration ppm. | Results No. of plants sq.rd. May 30, 1946 | Results Percent of original | Results No. of Plants sq. rd. Oct. 2, 1946 | Results Percent of original |
|---|---|---|---|---|---|---|---|---|
| 4 | 5-28-45, 2 p.m. | 592 | Dense stand | Dow A510 | 198 | 33 | 104 | 18 |
| 7 | " " | 965 | 21" high, | 1500 ppm. | 310 | 32 | 96 | 9 |
| 13 | " " | 596 | leaves succulent | 1½ gal. | 201 | 33 | 42 | 7 |
| 8 | " 3 p.m. | 1179 | " | Dow 510 | 348 | 29 | 190 | 16 |
| 10 | " " | 1074 | " | 1000 ppm. | 301 | 27 | 211 | 19 |
| 22 | " " | 641 | " | 1½ gal. | 201 | 31 | 40 | 6 |
| | | | | | Sept. 1, 1946 | | | |
| A1 | 5-23-46, 10 a. m. | 960 | " | Dow G652 | 333 | 34 | Plots resprayed 10-2-46. Results cannot be obtained until spring, 1947. | |
| A2 | "" " | 648 | " | 1500 ppm. | 360 | 55 | | |
| A3 | " " | 590 | " | 1½ gal. | 230 | 28 | | |
| B1 | " 11 a. m. | 960 | " | Dow G652 | 180 | 18 | | |
| B2 | " " | 594 | " | 1500 ppm. | 196 | 33 | | |
| B3 | " " | 604 | " | 1½ gal. | 103 | 17 | | |

Canada Thistle

Results obtained from spraying different 2,4-D formulations on Canada thistle, Crystal Lake, Iowa.

## Canada Thistle

Results obtained from spraying different 2,4-D formulations on Canada thistle, Crystal Lake, Iowa, during 1945-1946. Original infestation was heavy and of long standing.--A. L. Bakke (See footnotes for Stage of Growth and second and third treatments)

| Date of Initial Treatment | Chemical Used | Concentration and amount per sq. rd. | Results August 15 | Results June 19, 1946 No. of plants per sq. yd. | Results Aug. 14, 1946 No. of plants per sq. yd. | Results Oct. 1, 1946 No. of plants per sq. rd. | Remarks |
|---|---|---|---|---|---|---|---|
| 7-13-45 | Sodium chlorate | 1 lb. per gal. 2½ gal. | 10 young shoots | 0 | 6 | 0 | Grass killed in spots |
| " | Ammate | | plants killed 6 young shoots | 19 | 56 | 4 | Grass injured |
| | DuPont #4 | 1000 ppm. 2½ gal. | Tops of plants sprayed killed | 24 | 40 | 7 | No effect on timothy and |
| " | DuPont #3 | " | " | 22 | 17 | 5 | brome grass- |
| " | Dow A510 | " | " | 20 | 9 | 4 | alfalfa and |
| " | Weedone | " | " | 23 | 12 | 8 | clover killed |
| " | DuPont #1 | " | " | 18 | 12 | 3 | " |
| " | DuPont #2 | " | " | 15 | 16 | 12 | " |
| " | Chipman | " | " | 34 | 12 | 6 | " |
| " | 2,4-D in Carbowax | " | " | 16 | 18 | 18 | " |

Stage of growth after initial treatment: Full bud stage, 5 ft. tall, heavy growth, 200 plants per sq. rd.
Stage of growth after second treatment: 6" to 12" tall, heavy growth.

STage of growth after third treatment: Bud stage, 2-3' tall.

Stage of growth after fourth treatment: (9-10-46) 3" tall, 3/4 gal., 1000 ppm., thistles mowed August 14.

SECOND TREATMENT: October 4, 1945, 1½ gal.
THIRD TREATMENT: July 6, 1946, 1½ gal.
FOURTH TREATMENT: Sept. 11, 1946- 3/4 gal.

## Canada thistle

| Date of Treatment | Temperature | Infestation | Stage of Growth | Chemical Used | Results Aug. 1, 1946 Regrowth | Retreatment Chemical Used | Results Nov.1,1946 |
|---|---|---|---|---|---|---|---|
| June 21, 1946 | 70°F. Clear | In meadow : Rather heavy | Bud stage, 24" high, Ground mowed Aug. 15 | Weedone dust | 30% | Chipman 2,4-D | Plants curled and yellow. |
| | | | | Dow 2,4-D dust | 20% | Baker 2,4-D | |
| | | | | D. weed East-West application | 40% | North-South application | |
| Oct. 2, 1946 | 70° F. Clear | In pasture, 12 plants per sq. yd. Infestation old (40 yrs.) | Bushy, 8" tall, Mowed July 1 | Weed-no-more Dow Weed Killer Monsanto (triethylamine) 2,4-D | Result Nov. 1, 1946 Plants curled and yellow. | | |

## Canada Thistle

Results obtained from spraying Canada thistle with different 2,4--D formulations during 1946 in Meeker Co., Minnesota, U. S. Dept. of Agriculture, Bureau of Plant Industry, University of Minnesota --L. M. Stahler

| Plot No. | Date and hour of first application | Stage of growth Height, Density Infestation | Chemical Used | Concentretion ppm. Rate 1 gal. per sq. rd | Results 7-30-46 Percent of original | Results after retreatment 7-31-46 10-18-46 Percent of original |
|---|---|---|---|---|---|---|
| 1-5 | 6-21-46 | Heavy, dense infestation, | Dow Sodium Salt | 1000* | 8.0 | 0.5 |
| 6-20 | 4 p. m. | 2-8 inch leaves | " | 2000 | 4.0 | 0.0 |
| 2-14 | " | and stems, succulent. About | DuPont Ammonium salt | 1000 | 6.0 | 0.4 |
| 7-19 | " " | to shoot flower | " | 2000 | 5.0 | 0.8 |
| 3-13 | " " | stalks | U. S. Rubber Amine | 1000 | 38.0 | 26.0 |
| 8-18 | " " | | " | 2000 | 41.0 | 29.0 |
| 4-12 | " " | | Sherwin Williams ester | 1000 | 2.0 | 0.1 |
| 9-17 | " " | | " | 2000 | 6.0 | 0.0 |
| 5-11 | " " | | Weedone | 1000 | 19.0 | 4.0 |
| 10-16 | " " | | " | 2000 | 21.0 | 0.5 |

*Spray nozzle pressure 30#

Results obtained from spraying 2,4-D formulations on Canada thistle-Regal Dairy, St. Adolphe, Manitoba, Canada

| Plot No. | Date & Hr. | Stage of growth | Height in inches | Dense or Light | Succulant or dry. | Chemical used | Con. ppm. | Rate per sq. rd. Gal. | Plant or plant shoots per sq. rd. July 4 | Surviving- August 10. | Sept. 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | June 5 | Pre-bud | 3-5 | Med.-dense | Dry | Sosium salt | 1000 | 3/4 | 3 | 2 | 50 |
| 2. | 11-12 | " | " | " | " | Ethyl Ester | " | 3/4 | 2 | 2 | 50 |
| 3. | a.m. | " | " | " | " | Ester | " | " | 2 | 2 | 20 |
| 4. | " | " | " | Sparse | " | Amine salt | 2000 | 3/8 | 1 | 0 | 35 |
| 5. | " | " | " | Med.dense | " | Sodium salt | 2000 | " | 5 | 3 | 60 |
| 6. | " | " | " | " | " | Ethyl ester | " | " | 5 | 10 | 55 |
| 7. | " | " | " | " | " | Ester | " | 3/8 | 5 | 10 | 35 |
| 8. | " | " | " | " | " | Amine salt | " | 3/8 | 3 | 5 | 25 |
| 9. | " | " | " | Sparse | " | Sodium chlorate | " | 3/4 | 0 | 2 | 3 |
| 10. | " | " | " | Med-dense | " | Sodium salt | " | " | 2 | 5 | 55 |
| 11. | " | " | " | " | " | Ethyl ester | " | " | 5 | 15 | 55 |
| 12. | " | " | " | " | " | Ester | " | " | 2 | 2 | ∞ 45 |
| 13. | " | " | " | Sparse | " | Amine salt | " | " | 1 | 2 | 35 |

Knap sack sprayer used.

Sosium salt-Dow Chemical Company, Midland, Michigan
Ethyl ester-Weedone-American Chemical Paint Co., Ambler, Pa.
Ester- Green Cross Insecticides, 2873 Carter Street; Montreal, Quebec
Amine- Naugatuck Chemicals, Montreal, Quebec.

Topography - flat - soil Heavy caly Productivity-excellent, dry, subsoil-moist.

Temperature - 78°F. Nest 24 hours. Max 65, Min. 51, Humidity 41 percent, Wind velocity 15.8 mph.
First rain occurred 24 hours after treatment - 0.06 inch

Leafy Spurge

Results from spraying leafy spurge with different 2,4-D formulations, Ottertail County, Minnesota
Bureau of Plant Industry-University of Minnesota-L. H. Stahler. Ottertail Co. Minnesota.

Leafy Spurge

Results from spraying leafy spurge with different 2,4-D formulations, Otterteil County, Minnesota
Bureau of Plant Industry-University of Minnesota-L. H. Stahler. Otterteil Co. Minnesota.

| Plot No. | Date and hour of first application | Stage of growth Height, density Infestation | Chemical Used | Concentration ppm. Rate 1 gal. | per sq. rd. | Results Percent of original 6-4-46 | Percent of survival after retreatment with some chemicals 10-15-46 | |
|---|---|---|---|---|---|---|---|---|
| 1-13 | 8-21-45 | Heavy | Dow sodium salt | 1000 | | 92 | 86 | |
| 2-10 | 9 a.m. | Dense, full | " | 1500 | | 94 | 97 | |
| 3-15 | " | growth, 16" | " | 2000 | | 68 | 81 | |
| 4-16 | " | high, tissues succulent. | DuPont Ammonium salt | 1000 | | 82 | 88 | |
| 5-17 | " | " | " | 1500 | | 76 | 79 | |
| 6-18 | " | " | " | 2000 | | 88 | 91 | |
| 7-19 | " | " | Sherwin Williams ester | 1000 | | 91 | 77 | |
| 8-20 | " | " | " | 2000 | | 78 | 88 | |
| 12 | " | " | 5 percent sodium salt dust | ½ lb. | Per sq. rd. | 74 | 82 | |
| 24 | " | " | " | 1 lb. | Per sq. rd. | 56 | 71 | |
| Check untreated | " | " | No treatment | | | 100 | 100 | |

| | | | Brookings, County S. D. | | 6-30-46 | 10-22-46 | |
|---|---|---|---|---|---|---|---|
| 1 | 5-31-46 2 p.m. | Heavy, dense, succulent, infestation, full bloom, 30" high | Dow sodium salt | 1000 1 gal. | 8.0 | 88.0 | Flowers and seed formed |
| 6 | " | " | " | " | 11.0 | 76.0 | 10-22-46 |
| 2 | " | | DuPont Ammonium salt | | 14.0 | 62.0 | Few flowers weak |
| 7 | " | | " | " | 2.0 | 49.0 | " |
| 3 | " | | U.S.Rubber Amine | " | 49.0 | 100.00 | Flowers and |
| 8 | " | " | " | | 64.0 | 100.0 | seed " |
| 4 | " | " | Weed-No-More 40 | | | | |
| *30 Lbs. pressure on spray nozzle | | | Sherwin Wms.ester | " | 1.0 | 100.0 | " |
| 9 | " | " | " | " | 0.2 | 88.0 | " |
| 5 | " | " | " | " | 4.0 | 100.0 | " |
| 10 | " | " | " | " | 7.0 | 84.0 | Seeds ripe&fall |
| Check untreated | | " | No Treatment | " | 100 | 100 | Plants burn red-yel. |

Results obtained from spraying 2,4-D formulations on Canada thistle at St. Adolphe, Manitoba, Canada - Pat Smith.
1946

| Plot No. | Hour of day | Stage of growth | Height in inches | Dense or light | Succulent or dry | Chemical Used | Conc. ppm. | Rate per Sq.rd. Gals. | New Shoots Aug. 14 Percent | Percent of original stand Aug. 14, 1946 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. July | 1:00 | Bud | 6- | Dense | Succ. | So ium salt | 1000 | 3/8 | 15 | 5 |
| 2. 4 | | " | 14" | " | " | Ethyl ester | " | " | 15 | 3 |
| 3. 1946 | 3:00P.M. | " | | " | " | Ester | " | " | 20 | 2 |
| 4. " | " | " | " | " | " | Amine salt | " | " | 15 | 10 |
| 5. " | " | " | " | " | " | Sodium salt | " | 3/4 | 5 | 2 |
| 6. " | " | " | " | " | " | Ethyl ester | " | " | 5 | 5 |
| 7. " | " | " | " | " | " | Ester | " | " | 30 | 2 |
| 8. " | " | " | " | " | " | Amine | " | " | 15 | 4 |
| 9. " | " | " | " | " | " | Sodium Chlorate | 1 lb. | ½ | 7 | 0 |
| 10 " | " | " | " | " | " | Check | -- | -- | 100 | 100 |
| 11 " | " | " | " | " | " | Sodium salt | 2000 | 3/8 | 11 | 5 |
| 12 " | " | " | " | " | " | Ethyl ester | " | " | 8 | 25 |
| 13 " | " | " | " | " | " | Ester | " | " | 20 | 10 |
| 14 " | " | " | " | " | " | Amine salt | " | " | 5 | 8 |
| 15 " | " | " | " | " | " | Sodium salt | " | 3/4 | 6 | 10 |
| 16 " | " | " | " | " | " | Ethyl ester | " | " | 8 | 15 |
| 17 " | " | " | " | " | " | Ester | " | " | 7 | 8 |
| 18 " | " | " | " | " | " | Amine salt | " | " | 3 | 10 |

Topography - flat; soil - heavy clay; productivity - good.

Sodium salt - Dow Chemical Company, Midland, Michigan
Ethyl ester - Weedone - American Chemical Paint Co., Ambler, Pa.
Ester - Green Cross Insecticides 2873 Center St. Montreal, Quebec.
Amines - Naugatuck Chemicals, Montreal, Quebec.

EFFECT OF 2,4-D ON CANADA THISTLE

Columbus, Ohio. Patches of thistles in bluegrass pasture. Plots of 1 square rod, divided for re-treatment into half square rod plots. All treatments listed here killed practically 100% of the

Columbus, Ohio. Patches of thistles in bluegrass pasture. Plots of 1 square rod, divided for re-treatment into half square rod plots. All treatments listed here killed practically 100% of the treated tops. The first retreatment of each plot before September 16 was at 1500 ppm. regardless of the the concentration used earlier. All plots were retreated 9/16-20/ at 2000 ppm.--C. J. Willard

| Original treatment | | | Percent regrowth after initial spray | | | | | Percent regrowth after 1st retreatment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Stage of growth | conc. ppm. | Date of reading | Sodium Salt | Amine Salt | Butyl ester | Ethyl ester | Methyl ester | Date of reading | | Sodium Salt | Amine Salt | Butyl Ester | Ethyl Ester |
| Half each plot (a) retreated July 11; other half (b), Aug. 8; entire plots treated Sept. 16 | | | | | | | | | | | | | | |
| Apr. 20 | 6" high | 1500 | June 24 | 30 | 30 | 30 | | | (a) | Aug. 22 | 10 | 15 | 10 | |
| May 19 | Growing rapidly 16" high | 1500 | " | 5 | 10 | 5 | 5 | | (a) | Aug. 22 | 5 | 10 | 5 | 15 |
| | | | | | | | | | (b) | Aug. 22 | 2 | 5 | 2 | 2 |
| May 19 | " | 2000 | " | 5 | 5 | 10 | 5 | | (a) | " | 10 | 2 | 12 | 10 |
| | | | | | | | | | (b) | " | 10 | 3 | 10 | 5 |
| May 19 | " | 5000 | " | 1 | | 3 | | | (a) | " | 10 | | 12 | |
| | | | | | | | | | (b) | " | 5 | | 5 | |
| May 19 | " | 10000 | " | 2 | | 5 | | | (a) | " | 15 | | 10 | |
| | | | | | | | | | (b) | " | 10 | | 20 | |
| May 30 | Buds appearing 20" high | 1500 | " | 5 | 5 | 5 | 2 | | (a) | " | 10 | 8 | 10 | 10 |
| | | | | | | | | | (b) | " | 7 | 1 | 10 | 10 |
| May 30 | " | 2000 | " | 3 | 1 | 5 | 3 | | (a) | " | 5 | 10 | 10 | 15 |
| | | | | | | | | | (b) | " | 3 | 12 | 1 | 5 |
| May 30 | " | 3000 | " | 2 | | 3 | | | (a) | " | 8 | | 10 | |
| | | | | | | | | | (b) | " | 3 | | 5 | |
| May 31 | " | 5000 | " | 0 | | 0 | | | (a) | " | 8 | | 5 | |
| | | | | | | | | | (b) | " | 2 | | 2 | |
| May 31 | " | 10000 | " | 0 | | 2 | | | (a) | " | 8 | | 8 | |
| | | | | | | | | | (b) | " | 3 | | 3 | |
| Half of each plot retreated Aug. 8; entire plots retreated Sept. 16. | | | | | | | | | | | | | | |
| June10 | Late bud stage | 1500 | June 24 | 0 | 0 | 0 | 0 | | | Aug. 22 | 8 | 8 | 2 | 10 |
| | | | Aug. 22 | 10 | 15 | 10 | 12 | | | | | | | |
| June10 | " | 2000 | June 24 | 0 | | 0 | 1 | | | Aug. 22 | 5 | 5 | 5 | 5 |
| | | | Aug. 22 | 20 | 15 | 15 | 15 | | | | | | | |
| June10 | Late bud stage | 5000 | June 24 | 0 | | 0 | | | | Aug. 22 | 5 | | 8 | |
| | | | Aug. 22 | 15 | | 15 | | | | | | | | |
| June10 | " | 5000 | June 24 | 0 | | 0 | | | | Aug. 22 | 10 | | 15 | |
| | | | Aug. 22 | 20 | | 15 | | | | | | | | |



Continued on next page

| Original treatment | | | Percent regrowth after initial spray | | | | | | Percent regrow after 1st retreat. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Stage of Growth | Conc. ppm. | Date of reading | Sodium Salt | Amine Salt | Butyl Ester | Ethyl Ester | Methyl Ester | Date of reading | Sodium salt | Amine Salt | Butyl ester | Ethyl ester | |
| | | | Half of each plot retreated Aug. 8; entire plots retreated Sept. 16 | | | | | | | | | | | |
| June 10 | Late bud stage | 10000 | June 24 | 0 | | 2 | | | Aug. 22 | 10 | | 12 | | |
| | | | Aug. 22 | 20 | | 12 | | | | | | | | |
| June 24 | Full bloom | 1500 | Aug. 22 | 20 | 20 | 20 | 20 | | Sept.14 | 5 | 5 | 20 | 10 | |
| June 24 | " " | 2000 | Aug. 22 | 20 | 10 | 15 | 30 | | Sept.14 | 5 | 5 | 5 | 15 | |
| June 24 | " " | 5000 | Aug. 22 | 20 | | 25 | | | Sept.14 | 10 | | 15 | | |
| June 24 | " " | 10000 | Aug. 22 | 30 | | 20 | | | Sept.14 | 12 | | 15 | | |
| | | | Mowed before treating. Entire plots retreated Sept. 20 | | | | | | | | | | | |
| July 16 | (Vegetative: | 1500 | Sept. 18 | 20 | 15 | 20 | | 12 | | | | | | |
| July 16 | (mowed late: | 1500 | Sept. 18 | 25 | | 20 | | 50 | | | | | | |
| July 16 | (June 4"-8": | 2000 | Sept. 18 | 20 | 25 | 45 | | 20 | | | | | | |
| | (high. | | | | | | | | | | | | | |
| July 16 | " | 2000 | " | 15 | 25 | 50 | | 20 | | | | | | |
| July 16 | " | 3000 | " | 20 | | 45 | | 20 | | | | | | |
| July 16 | " | 5000 | " | 15 | | 20 | | | | | | | | |
| July 16 | " | 10000 | " | 15 | | 20 | | | | | | | | |
| Aug. 14 | (Vegetative: | 1500 | " | | | 15 | | 5 | | | | | | |
| Aug. 14 | (mowed late: | 1500 | " | | | 10 | | 5 | | | | | | |
| Aug. 14 | ( June. | 2000 | " | 5 | 10 | 10 | 10 | 10 | | | | | | |
| Aug. 14 | " | 2000 | " | 5 | 2 | 5 | 5 | 10 | | | | | | |
| Aug. 14 | " | 3000 | " | 5 | 5 | 2 | 2 | 5 | | | | | | |
| Aug. 14 | " | 3000 | " | 5 | 10 | 5 | 10 | 10 | | | | | | |
| Aug. 14 | " | 5000 | " | 2 | | 0 | | | | | | | | |
| Aug. 14 | " | 5000 | " | | | 3 | | | | | | | | |
| Aug. 14 | " | 10000 | " | 0 | | 0 | | | | | | | | |

The sodium salt was Dows; the amine salt, first Tufor, then Dows; the butyl ester, Weed-no-more; the ethyl ester, Weedone; the methyl ester, Dow G-654



ORIGINAL TREATMENTS. Plant treated: Canada Thistle. Location: Urbana, Illinois Cooperator - L. V. Sherwood

ORIGINAL TREATMENTS. Plant treated: Canada Thistle. Location: Urbana, Illinois Cooperator - L. V. Sherwood

| Plot No. | Date 1946 | Hour of Day | Stage of growth (Crop or Weed) | Leaves and Stems Ht. In. | Leaves and Stems Dense or Light | Leaves and Stems Succ. or Dry | Chemical Used | Conc. ppm. | Rate gals. per sq. rd. | Sprayer nozzle Pressure etc. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | June 17 | A.M. | Bud Stage | 18 | Light | Succ. | Chipman, 2,4-D | 1000 | 1 | 25-50 |
| 2 | June 9 | A.M. | " " | 20 | Medium | " | " | 1500 | 1 | " |
| 3 | June 3 | A.M. | " " | 24 | Dense | " | " | 2000 | 1 | " |
| 4 | June 17 | A.M. | " " | 15 | Light | " | Karmax | 1000 | 1 | " |
| 5 | June 17 | A.M. | " " | 20 | Medium | " | " | 1500 | 1 | " |
| 6 | June 9 | A.M. | " " | 20 | Medium | " | " | 2000 | 1 | " |
| 7 | June 3 | A.M. | " " | 24 | Dense | " | Conc, #6 | 1000 | 1 | " |
| 8 | June 9 | A.M. | " " | 20 | Medium | " | " | 1500 | 1 | " |
| 9 | June 3 | A.M. | " " | 24 | Dense | " | " | 2000 | 1 | " |
| 10 | June 17 | A.M. | " " | 15 | Light | " | Weed No More 40 | 1000 | 1 | " |
| 11 | June 9 | A.M. | " " | 15 | Light | " | " | 1500 | 1 | " |
| 12 | June 3 | A.M. | " " | 24 | Dense | " | " | 2000 | 1 | " |
| 13 | June 17 | A.M. | " " | 20 | Medium | " | Dow 654 | 1000 | 1 | " |
| 14 | June 9 | A.M. | " " | 24 | Dense | " | " | 1500 | 1 | " |
| 15 | June 17 | A.M. | " " | 15 | Light | " | " | 2000 | 1 | " |
| 16 | July 31 | P.M. | Blossoms Dry | 12 | Light | " | Weed No More 40 | 1500 | 1 | " |
| 17 | July 31 | P.M. | " " | 12 | Light | " | Conc. # 6 | 1500 | 1 | " |
| 18 | July 31 | P.M. | " " | 12 | Light | " | Chipman 2,4-D | 1500 | 1 | " |
| 19 | July 31 | P.M. | " " | 12 | Light | " | Tufor 40 | 1500 | 1 | " |
| 20 | July 31 | P.M. | " " | 24 | Dense | Med. Succ. | Weed No More 40 | 1500 | 1 | " |
| 21 | July 31 | P.M. | " " | 24 | Dense | " | Conc. # 6 | 1500 | 1 | " |
| 22 | Aug. 1 | A.M. | " " | 24 | Dense | " | Tufor 40 | 1500 | 1 | " |
| 23 | Aug. 1 | A.M. | " " | 24 | Dense | " | Chipman 2,4-D | 1500 | 1 | " |
| 24 | Aug. 1 | A.M. | " " | 24 | Dense | " | Tufor 40 | 1500 | 1 | " |

SOIL AND WEATHER DATA

| SOIL DATA | | | Temp. °F. | | | Cloudiness | Humidity | Wind velocity | 1st rain after treatment | |
|---|---|---|---|---|---|---|---|---|---|---|
| Topography, pH, type, texture, productivity | Moisture Top-Soil | Moisture Sub-Soil | When treated | Next 24 Hours Max. | Next 24 Hours Min. | Pct. | Pct. | mph. | Hours, Days | Amount In. |
| Saybrook Silt Loam pH 5.8-6.0, Rolling Prairie, Med. Fertility | Moist | Moist | 85 | 90 | 72 | Partly Cloudy | 71 | 8 | 9:30-11a.m., June 18 | 1.60 |
| " " " | " | " | 78 | 88 | 55 | Clear | 59 | 7 | 10:30 p.m.-9 a.m. June12 | .84 |
| " " " | " | " | 65 | 74 | 44 | Clear | 40 | 6 | 10:45-11a.m., Jun. 9 | .11 |
| " " " | " | " | 85 | 90 | 72 | Partly Cloudy | 71 | 8 | 9:30-11a.m., Jun 18 | 1.60 |
| " " " | " | " | " | " | " | " | " | " | | " |
| " " " | " | " | 78 | 88 | 55 | Clear | 59 | 7 | 10:30p.m.-92.m., Jun.12 | .84 |
| " " " | " | " | 65 | 74 | 44 | " | 40 | 6 | 10:45-11a.m. Jun. 9 | .11 |
| " " " | " | " | 78 | 88 | 55 | " | 59 | 7 | 10:30P.m.-9a.m., Jun.12 | .84 |
| " " " | " | " | 65 | 74 | 44 | " | 40 | 6 | 10:45 11a.m., June 9 | .11 |
| " " " | " | " | 85 | 90 | 72 | Partly Cloudy | 71 | 8 | 9:30-11a.m., June 18 | 1.60 |
| " " " | " | " | 78 | 88 | 55 | Clear | 59 | 7 | 10:30 p.m.-9a.m., Jun.12 | .84 |
| " " " | " | " | 65 | 74 | 44 | Clear | 40 | 6 | 10:45-11a.m., Jun. 9 | .11 |
| " " " | " | " | 85 | 90 | 72 | Partly Cloudy | 71 | 8 | 9:30-11a.m., Jun. 18 | 1.60 |
| " " " | " | " | 78 | 88 | 55 | Clear | 59 | 7 | 10:30 p.m.-9a.m., Jun.12 | .84 |
| " " " | " | " | 85 | 90 | 72 | Partly Cloudy | 71 | 8 | 9:30-11a.m.-June18 | 1.60 |
| Drummer Clay Loam pH 6.7, Level Prairie, Dry High Fertility | Moder. | | 82 | 85 | 59 | Clear | 78 | 5 | 1-7 p.m., August 5 | .71 |
| " " " | " | " | " | " | " | " | " | " | " | " |
| " " " | " | " | " | " | " | " | " | " | " | " |
| " " " | " | " | " | " | " | " | " | " | " | " |
| Branton Silt Loam pH 6.3-6.4, Gently Sloping, Med. High Fertility | Dry | " | " | " | " | " | " | " | " | " |
| " " " " " | " | " | " | " | " | " | " | " | " | " |
| Drummer Clay Loam pH 6.7, Level Prairie, High Fertility | Med. | " | 86 | 87 | 59 | " | 61 | 4 | " | " |
| Saybrook Silt Loam pH 5.8-6.0, Rolling Prairie, Med. Fertility | Dry | " | " | " | " | " | " | " | " | " |
| " " " | " | " | " | " | " | " | " | " | " | " |

## RESULTS OF TREATMENTS

| Plants or plant shoots per sq. rod | | Treated Tops Killed | | |
|---|---|---|---|---|
| Resprouting on: 8 weeks after treatment | | 1 Week After Treat. | 2 Weeks After Treat. | 6 Weeks After Treat. |
| No. of Original* | No. | Pct. | Pct. | Pct. |
| 100 | Looks like practically all plants on all plots have resprouted. | 85 | 95 | 98 |
| 500 | " | 100 | 100 | 100 |
| 1000 | " | 100 | 100 | 100 |
| 100 | " | 71 | 85 | 92 |
| 500 | " | 94 | 98 | 99 |
| 1000 | " | 100 | 100 | 100 |
| 1000 | " | 100 | 100 | 100 |
| 500 | " | 100 | 100 | 100 |
| 1000 | " | 100 | 100 | 100 |
| 100 | " | 77 | 87 | 95 |
| 100 | " | 100 | 100 | 100 |
| 1000 | " | 100 | 100 | 100 |
| 500 | " | 60 | 75 | 87 |
| 1000 | " | 100 | 100 | 100 |
| 100 | " | 95 | 100 | 100 |
| 100 | " | 100 | 100 | 100 |
| 100 | " | 80 | 100 | 100 |
| 100 | " | 85 | 100 | 100 |
| 100 | " | 90 | 100 | 100 |
| 1000 | " | 60 | 85 | 95 |
| 1000 | " | 40 | 75 | 95 |
| 1000 | " | 90 | 95 | - |
| 1000 | " | 60 | 85 | 90 |
| 1000 | " | 60 | 85 | 90 |

* Round figure approximations based on actual counts on first three plots, and the remaining plots compared to these.

## Response of Canada Thistles to Several Preparations of Chlorinated Phenoxyacetic Acids

Kenneth P. Buchholtz - University of Wisconsin, Madison

This experiment can be included under part I-1 of the Uniform Plan of Experiments although the outline is not followed exactly. Six preparations of 2,4-D and 2 preparations of 2,4-5-trichlorophenoxyacetic acid were used. All preparations were used in water sprays at the concentration of 1000 ppm. calculated on the basis of the parent acid or parent acid equivalent. A rate of 3/4 gallon of spray per sq. rd. was used throughout the experiment. This is equivalent to application of the growth regulants at the rate of 1 pound per acre.

The experimental area was on a silt loam soil, having a pH of about 6 and a high level of fertility. It was level in topography. The area was fitted as for crop production in the early spring. After thistle growth started the area was divided into plots containing $\frac{1}{2}$ square rod each with 3 foot alleys between plots. Plant counts were made on each plot when the thistles were about t inches high, using quadrats. The 9 treatments, including one check, were randomized and 3 replications were used. The spray applications were made on July 3, 1946, from 2 to 4 p.m. The temperature was 80°F. with a relative humidity of 57 per cent. It was a sunny day. The soil was moist. No rain occurred for 6 days after treatment. The thistles were in an early bud stage of development and were growing rapidly when sprayed. A Hudson knapsack sprayer fitted with a Spraying Systems nozzle and a No. 8004 orifice was used. Alleys between plots were kept mowed and were treated with sodium chlorate to prevent root invasion from adjacent areas.

### Effect on stem kill.

After the treatments were applied estimates of the extent of the stem killing were taken on several dates. The 1 pound per acre application proved to be rather light since the stems of the thistles were killed rather slowly. This slow kill was an aid in detecting differences in the rate of kill shown by the different preparations. The data collected on September 5, 1946 appear to be representative. A summary of the average percentages of stems killed by this date is given in Table 1.

The variability between plots was large so that a difference of 30 per cent in stems killed is necessary to show significant differences. The data shows that the amine salt of 2,4-D gave the best kill of stems. The 80 per cent kill obtained with this preparation is significantly better than that obtained with the butyl ester preparation of 2,4-D or the 2,4-5 acid preparations. It is clear that the two 2,4-5 preparations were materially poorer in causing the death of the Canada thistle stems. The differences between the 2,4-D preparations cannot be considered seriously due to the high variability of the data.

### Effect on regrowth.

On October 31 an estimate was made of the number of Canada thistle shoots appearing on the various plots. Using the plant counts obtained before treatment the percentages of reduction in shoot number were calculated for each plot.

These figures are of value for preliminary observations only. They are subject to an error due to the incomplete recovery of the treated plants at the October observation date. The data is also subject to the error introduced by the estimation of the shoot growth. Data based on plant counts obtained in the spring of 1947 will be much more reliable. Even so it appears that such preliminary data may be of value in suggesting trends.

The shoot reduction data was averaged and a summary is shown in Table 1. A statistical analysis showed that the data was quite variable and that a difference of 29.7 per cent was required to show significant differences between treatments. The amine salt of 2,4-D gave the highest reduction in shoot regrowth. The 74.6 per cent reduction obtained with this preparation was significantly greater than the reductions obtained with the ethyl and butyl esters of 2,4-D and the two 2,4 5 preparations. The 2,4-5 preparations appear to be distinctly less effective in preventing the regrowth of shoots. It is not definitely known whether a good reduction in shoot growth shortly after treatment is correlated with good root kill and ultimate control of the thistles. It seems likely that this might be the case and in that event, preparations giving a high percentage of reduction would be the most promising ones to use in further work.

Summary.

The amine salt of 2,4-D gave the highest percentage of stem kill 2 months after treatment. The percentage of stem kill obtained was not statistically different from the 5 other 2,4 D preparations tested, however.

The amine salt of 2,4-D gave the highest percentage of reduction in shoot regrowth 3 months after treatment. It gave statistically greater reductions than did the ethyl and butyl esters of 2,4-D. It was not significantly different from the reductions obtained with the methyl ester, the sodium salt of the free acid preparations of 2,4-D.

The amine and free acid preparations of 2,4-5 were distinctly lower and in many cases significantly lower than the 2,4-D preparations in stem kill percentages and percentages of shoot reduction obtained.

Table 1. A summary of the percentages of Canada thistle stem kill and shoot reductions following application of several preparations of chlorinated phenoxyacetic acids in 1000ppm. sprays.

| Material | Preparation | Source | Stems killed 9/5/46 Percent | Shoot Reduction 10/31/46 Percent |
|---|---|---|---|---|
| 2,4-dichlorophenoxt-acetic acid | Methyl ester | G654 - Dow Chemical Co. | 73.0 | 53.6 |
| " | Ethyl ester | Weedone - American Chemical Paint Co. | 50.0 | 43.9 |
| " | Butyl ester | Weed-No-More 40 - Sherwin-Williams Chem. Co. | 47.0 | 27.1 |
| " | Sodium salt | A510 - Dow Chemical Co. | 63.0 | 48.5 |
| " | Amine salt | Tufor 40 - U. S.Rubber Co. | 80.0 | 74.6 |
| " | Free acid | Free acid in carbowax | 67.0 | 49.0 |
| 2,4,5-trichloro-phenoxyacetic acid | Amine salt | U. S. Rubber Co. | 33.0 | 17.1 |
| | Free acid | Free acid in Carbowax | 40.0 | 24.4 |
| M.S.D. between treatments at the 5% level | | | 30.0 | 29.7 |

Mr. Timmons. Thank you Dr Bakke. A few minutes are left. Does anyone have a question or a contribution to make, if so, they may have the floor.

Mr. Viehmeyer. May I throw a few rocks at the research program? I think that our present method of comparing methods is probably plant silly. There is a factor we are overlooking. We must, if we are going to compare chemicals, use them on plants that are similar. We must have plants that are identical. Get away from that wake up and recognize the fact. Until that time, we are just fiddling around in the dark.

L. W. Kephart. We do not have a good method of valuating chemicals. Something we have to have sooner or later. The question I wish to ask is will chemicals react on some of our test plants as they will to our mixed up populations on perennial weeds.

Mr. Viehmeyer. Probable they won't but at least we will know if there is a difference between chemicals. Different responses on different weeds. We will have different responses between waxey leaves and others.

Mr. Wood. I hesitate to take up to much time. In Manitoba alot of work has been done on leafy spurs. In 1945 above one-third of trial work was devoted to leafy spurs. In all work with leafy spurs, we have had nothing but disappointment- tried under every condition. We can kill the top of leafy spurs with any product without any difficulty, but it comes back and comes back even after the 2nd and third treatments. It is true that after 2nd and 3rd treatments they are pretty well thinned out, but we do not consider from all the work that we have won with leafy spurge. We still hold out a great deal of hope. Other workers may have different points of view than that. Canada Thistle is an important weed with us. We have had very encouraging work with Canada Thistle. 2-4D holds out every great hope for this thistle especially during the very early state--around free budding stage.

Mr. Briggs. Leafy spurge is twice as hard to kill as other weeds. We must be given tests on the age of these plants. Thistles are a great problem, and we are very much concerned over this. I think we have had as much experience with weeds as most anyone from Kansas.

Mr. Timmons. We must be getting on to our next portion of the program. Prof. J. W. Zahnley.

## Summary of the Effect of 2,4-D on Hoary Cress and certain other Perennial Weeds

This report summarizes briefly the work of 27 experiments on 17 species of perennial weeds. These tests followed in more or less detail the outline for uniform experiments I and IV. Since many of the tests had been continued only one season or were carried on in only one location, the results in those cases must be considered as preliminary.

Hoary Cress (Lepidium draba)

Tests with 2,4-D were carried on at five locations. Four of the six experiments reported indicate significant reductions in stand. One test with three applications in strong grass competition has reduced the stand 95 to 98 percent by the end of the second season following the first treatment. These applications were made in the spring of the first season and spring and fall of the second season. Another test without competitive growth shows the stand materially increased over the original even though there was 60 to 90 per cent injury to the tops following treatment.

One experiment was on land from top of a hill to bottom of a ravine. The three groups of plots had to be considered spearately. On the higher ground, the stand was actually greater in October 1946 than in September 1945. Only on the lower ground where the moisture supply was more favorable was there a reduction in stand.

Time of application is in favor of treatment in the prebud and fall rosette stage.

Concentration: The concentration of 2000 ppm. shows slightly better than lower dilutions but the results are not very consistent.

Rate: The data shows that a 2½ gallon rate is slightly better than lower rates but the results are not significant.

Type of 2,4-D: The esters show affect much more quickly and on the average, there is somewhat less regrowth as long as a year after treatment.

Attention is called to the desirability of withholding final record of results until the season following the treatment.

Sow Thistle (Sonchus arvensis)

Reports were received from three locations covering tests with the four types of 2,4-D in concentrations of 1000 and 2000 ppm. applied at rates of 3/4, 1 and 1½ gallons per square rod. Stages of growth at the time of application were designated as rosette stage, 2 to 8 inches high, and bud-flower stage. The growth at 2 to 8 inches high was described as dense succulent vegetation. Since many of the plants remain in the rosette stage all season, the effect upon plants at different stages of growth is difficult to determine. The evidence including results from 1945 seemed to be in favor of applications at the bud-flowering stage. No consistent difference was observed in the effectiveness of the different concentrations or rates used.

The esters seemed to be most effective of all the forms used. Regrowth was reduced to as low as 1 to 6 percent in some cases but in others there was no apparent reduction in stand. Sodium chlorate appeared to be more effective than 2,4-D in one of the tests. More work is needed on perennial sow thistle.

## Dogbane (Apocynum cannabinum)

Two experiments were reported on dogbane. One compared 11 different 2,4-D formulations at concentration of 1000 ppm. and six formulations at 2000 ppm. One formulation was applied at 500 and 1500 ppm. concentration and 3/4 and 2¼ gallons while all the otherw were at the rate of 1½ gallons. The plants were beginning to bloom at the time of treatment and the soil was wet but dry conditions followed soon after and continued to the end of the season.

Sodium chlorate was applied dry at 4, 6 and 8 pounds per square rod and Borascu at 10, 15 and 20 pounds per square rod October 11, 1945. The 2,4-D treatments were applied July 12, 1945.

Plant counts July 5, 1946, showed no complete kills with 2,4-D. Reduction in stands of 36 to 95 per cent were obtained. An acid formulation and an ester seemed somewhat more effective than the salts. There was no consistent difference in the effect of 1000 and 2000 ppm. concentrations in one test but in the other the higher concentration gave 13 per cent survival against 24 per cent for the 1000 ppm. concentration.

Results of most of the treatments were regarded as unsatisfactory and indicate that 2,4-D is even less effective on dogbane than on bindweed. Borascu at 20 pounds gave a complete kill of dogbane in both replicates. Chlorate at 8 pounds gave results similar to 20 pounds Borascu.

## Russian Knapweed (Centaurea picris)

Two tests were reported with Russian Knapweed, one in a bluegrass lawn and the other in cultivated land sown to rye the previous fall and pastured close throughout the winter and early spring. Plots treated in the bluegrass sod with an ester 1500 ppm. applied in early bud stage showed some apparent reduction in stand five months after treatment. The infestation on cultivated land was treated in the late bud stage with several formulations at different concentrations and rates. Most of the treatments had little or no noticeable effect upon the top growth. Observations made near the end of the growing season indicated that none of the 2,4-D treatments were effective.

## Bur Ragweed (Franseria tomentosa)

A single but well conducted test was reported for bur ragweed in which the four forms of 2,4-D were used with sodium chlorate as the check. Applications were made in June 1945 at the rapid growth stage and results recorded in June, 1946. Dry sodium chlorate was applied in September, 1945 at rates of 4 and 6 pounds per square rod.

Results: Sodium chlorate gave complete kill at both rates. Regrowth of 15 to 57 percent occurred on the plots treated with 2,4-D. The sodium salt reduced the stand more than the other 2,4-D products. The esters, acid, and ammonium salt followed in the order named.

There was no consistent difference in concentration and no highly consistent difference in type of formulation.

In this experiment 2,4-D was not effective in completely eliminating bur ragweed. Sodium was highly effective.

Blueweed (Helianthus ciliaris)

Three reports on work with Blueweed (Helianthus ciliaris) were received, one of which followed closely the uniform plan for Experiment IV. In this test, 13 preparations were used at three stages of growth all with concentration of 2000 ppm. On the whole, there was no significant difference in the effectiveness of 2,4-D when applied at the rapid growth prebud, budding, and full bloom stages. The average per cent survival from treatments at these stages was 30 for the rapid growth prebud, 35 for budding and 36 for the full bloom.

The average percent survival on plots treated with the sodium salts was 54. The comparative figure for ammonium salts was 35, esters 16 and amines 17. Of the three best kills two were from esters and one from an amine salt. Complete kills were reported for the esters used at the budding stage and at full bloom, one instance each and on one plot treated with an amine applied at full bloom.

In another test complete kills were reported from the use of 3000 ppm. of an ester compared with 97.4 percent for a sodium salt. When 1500 ppm. were used, the results were 98.7 kill for the esters and 98.3 for the sodium salt.

Climbing Milkweed (Gonolobus laevis)

Two sodium salt preparations were applied August 23, 1945, at rapid growth stage after disking following harvest at concentrations of 1000 and 2000 ppm. Data taken May 4, 1946, showed survival of 17 percent for the 1000 ppm. concentration and 11 percent for the 2000 ppm.

Similar treatments made June 6, 1946, and results recorded August 4 and September 4 showed a marked increase in number of plants over the original stand for both the 1000 ppm. and the 2000 ppm. rates. These were treated when the top soil was dry and subsoil moist. Dry hot weather prevailed for several weeks after treatment. However, both top and subsoil were dry when the August 23, 1945, treatment was made on disked grain stubble. From these results it appears that 2,4-D is not effective for control of climbing milkweed.

Wild Rose (Rosa suffulta)

Two sodium salts were applied to wild rose August 23, 1945, on disked grain stubble (same treatment as on the late application to climbing milkweed). Data taken May 4, 1946, showed no kill. Resprouting ranged from 75 to 167 percent.

Sililar treatment made June 6, 1946, and results recorded August 5 showed no kill. Final count of stands was more than double the original on the 1000 ppm plots and 100 per cent of the original on the 2000 ppm.

Poverty weed (Iva axillaris)

Applications at concentrations of 2000 ppm. were made August 15, 1946, when weeds were in the flowering stage. Observations made two months after treatment showed no regrowth for the esters, 35 percent for the amines, and 82 percent for the ammonium salt. The report on this test noted that final results could not be obtained until the summer of 1947.

Wild Garlic (Allium vineale)

Wild garlic was treated April 2, 1946, 1500 ppm. rapid growth stage when new bulblets were just starting to form. Results on triplicate plots showed an average survival November 1 of 21 to 30 percent of the original counts which ranged from 590 to 1179 plants per square rod. The difference between amines, salts and esters was insignificant.

Spurge Nettle (Jatropa texana)

Applications were made in early bloom (May 20), late bloom or early seed stage (June 15) and mature (July 15) with concentrations of 500,1000, 1500 and 2000 ppm. The tops seemed to be easy to kill and 500 ppm. seemed to do as well as the stronger concentrations. No sprouts were showing at the end of the first 30-day period. However, at 60 and 90 days after treatment 57 to 74 percent survival was indicated on the plots treated May 20. Those treated June 15 showed no regrowth at the end of 60 days and 0 to 10 percent at 90 days. The two esters at 1500 ppm. showed 0 and 1 per cent regrowth. No regrowth and appeared on the plots treated July 15 at the time the report was made in November, however, examination of the root systems indicated that results would be similar to those on the June 15 treatments.

White Horse Nettle (Solanum elaeagnifolium)

Concentrations of 500, 1000, 1500 and 2000 were applied on June 29 when the plants were blooming and forming seed. The esters gave 100 percent kill of tops in all plots except where only 500 ppm. concentration was used. However, there was regrowth at the end of 120 days of 15 to 50 percent. Results with 1500 ppm. gave results best 1000 ppm. second best followed by 2000 and 500 ppm. poorest. The amines and sodium salts failed to kill the tops. The report noted, however, that under certain conditions the tops have been killed with the salts.

Bladder Campion (Silene latifolia)

Each of the four types of 2,4-D preparations were applied in concentrations of 1000 and 2000 ppm. at bud flower stage June 26 and at the seed setting stage July 5 at the rate of 3/4 gallon per square rod. The growth was described as dense, succulent at the time of treatment. Results as observed September 4 (55 and 64 days after treatment) showed survival of 85 to 100% for all treatments. Apparently none of the plants were killed below the crown and in most cases very few stems were killed down to the roots.

Gumweed (Grindelia squarrosa)

Representatives of the four types were applied to gumweed in concentrations of 1000 and 2000 ppm. at the bud forming stage July 8 and at full bloom August 12 at the rate of one gallon per square rod. The growth at time of application, was described as dense succulent. The results were recorded for September 11. Treatment at the bud forming stage was more effective than that made at full bloom. Regrowth ranged from 10% to 0 two months after treatment.

Hedge Bindweed (Convolvulus sepium)

The four types of preparations were applied to hedge bindweed in concentrations of 500 and 1000 ppm. at the rate of 1½ gal. per sq. rod, at the prebud state (June 22) and when 50% of the buds were open, that is 50% bloom July 22. There was no regrowth on any of the plots of the later treatment when the notes were taken August 26.

The first series was in an alfalfa field, and 75% or more of the alfalfa was destroyed on the treated area. The first treatment, prebud stage failed to kill from 4 to 30% of the plants on plots treated with the 500 ppm. concentration and about half that proportion on plots where 1000 ppm. was applied. There was no consistent difference in the effectiveness of the salts, acid, esters, and amines. The operator noted that extensive trials in 1945 left the plots with only limited re-infestation in 1946.

Western Ragweed (Ambrosia coronopifolia)

Twenty commercial preparations representing the four types of formulations were applied to western ragweed June 5 and Oct. 12 in concentrations of 1500 and 1000 ppm. respectively. No regrowth appeared on plots treated with the esters after the first application. Only a trace of regrowth appeared on those treated with the free acid and the basic salts. The amines gave the poorest results with 5% regrowth 117 days after treatment. These tests indicate that 2-4D is highly effective on these perennial species of Ambrosia.

Mr. Timmons. Thank you Dr. Zahnley. We have some more time for discussion before we take up the next report. Anyone have a contribution or a question to ask on these weeds Mr. Zahnley reported on?

Mr. Hall. I would like to know whether or not there is anyone here from Utah. I have heard some remarkable results were obtained on hoary cress.

Mr. Thornton. We haven't had much luck with hoary cress. At the mature stage we have had very poor results.

Mr. Timmons. Anyone else who would like to ask a question?

Mr. Manske. About this blue wood, if you spray just the time the flowers are open, that regrowth that comes last is sprayed when four inches high and then is thoroughly killed. Some types we have eliminated entirely.

Mr. Timmons. We might use time later on for discussion but now, we will hear Dr. Buchholtz.

## Summary of Reports on Use of 2,4-D for Killing Woody Shrubs and Trees

No extensive studies were reported on woody shrubs and trees in 1946. Fragmentary reports and observations were received from Ontario, Manitoba, Minnesota, Kansas, Ohio and Wisconsin. Information was received on twenty species of plants with more cooperators reporting on poison ivy than on any other plant.

The reports indicate that poison ivy can usually be killed with sprays containing 2,4-D preparations. Best kills were obtained by using 1000 and 2000 ppm. spray solutions. On the basis of a few observations it appeared that there were no advantage in using concentrations greater than 2000 ppm. Concentrations lower than 1000 ppm. always gave poorer kills in the results reported.

Results shown in Table 1 indicate that in Manitoba poor kills of poison ivy were obtained with certain sodium salt preparations of 2,4-D. This may have been due to the use of water containing salts which prohibited the dissolution of the 2,4-D preparations. Results from other stations shown in Table 2 indicated that the sodium, the ammonium, the amine, the free acid and the ester preparations of 2,4 D were roughly equivalent in herbicidal action on poison ivy. Workers at the Ohio station stated that the ester preparations gave better and faster kills of poison ivy than did the others.

In Ontario, early applications made soon after the poison ivy plants had leafed out gave much the best control as is shown by the data in Table 2. In Minnesota, the earlier applications gave slightly better results than those made during the summer, while in Ohio good kills were obtained from applications made on several dates during the spring and summer.

In one instance in Minnesota, a dust preparation of 2-4D was found to give as satisfactory results in the control of poison ivy as did water sprays. The greatly reduced weight of material required when using a dust preparation may make it a desirable product to use in inacessible areas where water supply and transport is a problem.

Buckbrush was treated with several concentrations of 2,4-D sprays in studies in Kansas and Minnesota The results from Kansas were somewhat more favorable than those from Minnesota but satisfactory kills of top growth were not obtained in either state.

Results on a number of woody shrubs and trees showed great variability of response. Poor kills of blackberry, pine and dogwood were reported. The kill of willows was variable. Box elder, hazelnut, sumac and some other species were usually killed rather readily.. Details of the information reported is given in Table 3.

Table 1. Summary of Poison Ivy shoot reductions observed one year after treatment with several preparations of 2,4-D at several application rates.

| 2,4-D Preparation | Source | Concentration | Rate | Date sprayed | Growth stage | Shoot Reduction in 1946 | Station |
|---|---|---|---|---|---|---|---|
| | | ppm. | U.S.gal.sq.rd. | | | Percent | |
| Acid in carbowax | ---- | 250 | 3.25 | 6/26/45 | ---- | 56 | Ontario |
| " | ---- | 500 | " | " | ---- | 65 | |
| " | ---- | 1000 | " | " | ---- | 94 | |
| " | ---- | 2000 | " | " | ---- | 94 | |
| $NH_4$ salt | DuPont IN-6065 | 1000 | " | " | ---- | 95 | |
| " | " | 2000 | " | " | ---- | 97 | |
| Na salt | DuPont IN-4311-A9 | 1000 | " | " | ---- | 93 | |
| " | " | 2000 | " | " | ---- | 96 | |
| Na salt | DuPont IN-4311-A9 | 1250 | 1.50 | 7/14/45 | Succulent | 55 | Manitoba |
| " | " | 2500 | " | " | " | 96 | |
| " | Chipman | 1000 | " | " | " | 0 | |
| " | S.A.C. | 1000 | " | " | " | 0 | |
| " | Dow | 1000 | " | 7/28/45 | " | 25 | |
| Acid | Weedanol | 1000 | " | " | " | 82 | |
| Acid in carbowax | ---- | 520 | " | 7/30/45 | " | 10 | |
| " | ---- | 1040 | " | " | " | 99 | |
| $NH_4$ salt | DuPont IN-6065 | 1000 | " | " | " | 100 | |
| " | " | 2000 | " | " | " | 100 | |
| Amine salt | Naugatuck | 1700 | " | 7/14/45 | " | 99 | |
| Na salt | Dow | 1000 | 1.50 | 6/28/45 | Bloom | 100 | Minn. |
| " | " | 1500 | " | " | " | 100 | |
| $NH_4$ salt | DuPont | 1000 | " | " | " | 100 | |
| " | " | 1500 | " | " | " | 99 | |
| 5% Na salt dust | ---- | -- | ½lb./sq.rd. | " | " | 100 | |

Table 2. A summary of Poison Ivy shoot reduction percentages observed in the fall of 1946 after treatment with several preparations of 2,4-D on several dates.

| Year | Month | Application Rate U. S. gal/ sq.rd. | Application ppm. | 2,4-D Preparation Methyl Pct. | Ethyl Pct. | Butyl Pct. | Amine Pct. | Na Pct. | $NH_4$ Pct. | Acid Pct. | Station |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1945 | June | 3.25 | 1000 | | | | | 93 | 95 | 88 | Ontario |
| | July | 3.25 | 1000 | | | | | | | 21 | |
| | Aug. | 3.25 | 1000 | | | | | | | 11 | |
| | Sept. | 3.25 | 1000 | | | | | | | 6 | |
| 1945 | June | 1.50 | 1000 | | | | | 100 | 100 | | Minnesota |
| | Aug. | 1.50 | 1000 | | | 95 | | 82 | 85 | | |
| | June | 1.50 | 1500 | | | | | 99 | 100 | | |
| | Aug. | 1.50 | 1500 | | | 98 | | 95 | 95 | | |
| 1946 | June | 1.50 | 1500 | 82 | | 98 | | 80 | | | Ohio |
| | July | 1.50 | 1500 | 80 | | | | | | | |
| | Aug. | 1.50 | 1500 | 98 | | | | | | | |
| | June | 1.50 | 2000 | 91 | 96 | 77 | 99 | 87 | | | |
| | July | 1.50 | 2000 | 100 | | 88 | | 100 | | | |
| | Aug. | 1.50 | 2000 | 98 | | 93 | | 96 | | | |
| | June | 1.50 | 3000 | 95 | | | | | | | |
| | July | 1.50 | 3000 | 97 | | | 80 | 85 | | | |
| | Aug. | 1.50 | 3000 | 98 | | 100 | | 86 | | | |

Table 3. A summary of results obtained by treating various woody shrubs and trees with 2,4D preparations.

| Shrub or Tree | Size | Year | Date | 2,4-D Treatments Material | ppm. | Remarks in fall of 1946 | Station |
|---|---|---|---|---|---|---|---|
| Alder | ------ | 1945 | Summer | All prep. | 1000 | Killed | Minn. |
| Birch, black | ------ | " | Spring | All preps. | 1000 | Killed | Minn. |
| Box elder | 4 ft. | 1945 | Spring | Na salt | 1000 | Killed | Wisc. |
| " " | Seedling to 10 ft. | 1946 | " | Na salt | 1000 | Killed | Wisc. |
| Buckbrush | ------ | 1945 | ---- | All preps. | 2000 | Resistant, no kill | Minn. |
| " | ------ | 1946 | Spring | Na salt | 1500 | Resistant, no kill | Kansas |
| " | ------ | " | " | $NH_4$ salt | 1500 | Resistant, slight kill | " |
| " | ------ | " | " | Amine salt | 1500 | Resistant, no kill | " |
| " | ------ | " | " | Ester | 1500 | Fair kill, much regrowth | " |
| Cedar, red | ------ | 1945 | Spring | All preps. | All rates | Tolerant, recovers | Minn. |
| Dogwood | ------ | 1945 | ---- | All preps. | All rates | Very tolerant | Minn. |
| Grape, wild | ------ | 1946 | Spring | Na salt | 1000 | Killed | Wisc. |
| Hazelnut | ------ | 1945 | Spring | All preps. | 1000 | Killed | Minn. |
| " | ------ | " | Summer | All preps | 1000 | Partially killed | " |
| " | 6 ft. | 1946 | Spring | Na salt | 1000 | Killed | Wisc. |
| Maple | Seedling to 8 ft. | 1945 | Spring | All preps. | 1500 | Killed | Minn. |
| " | | " | Fall | All preps. | 1500 | Quite resistant | " |
| Oak | Seedling to 8 ft. | 1945 | Spring | Ester | 1000 | Killed | Minn. |
| " | Stump sprouts | " | " | Ester | 1000 | Killed | " |
| Pinus spp. | ------ | 1945 | Spring | All preps. | All rates | Tolerant, recovers | Minn. |
| Poison sumac | Seedling to 6 ft. | 1945 | Spring | Ester | 1000 | Killed | Minn. |
| Poplar | Seedling to 6 ft. | 1945 | Spring | All preps. | 1500 | Killed | " |
| " | " " " " | " | Summer | All preps. | 1500 | Injured but recovers | " |
| " | Over 6 ft. | " | ---- | All preps. | 1500 | Quite resistant | " |
| Prickly ash | ------ | 1945 | Spring | All preps. | 1000 | Killed | Minn. |
| " " | ------ | " | Summer | All preps. | 1000 | Tolerant | " |
| Prunus spp. | ------ | " | Spring | All preps. | 1000 | Killed | " |
| " " | ------ | " | Summer | All preps. | 1000 | Partially killed | " |
| Raspberry, wild | ------ | 1945 | ---- | All preps. | All rates | Very tolerant | Minn. |
| Sumac | 5 ft. | 1945 | Spring | Na salt | 1000 | Killed | " |
| " | " | 1945 | " | $NH_4$ salt | 1000 | Killed | " |
| " | " | " | Summer | Na salt | 1000 | Mostly killed | " |

Table 3. Cont.

| Shrub or Tree | Size | Year | Date | 2,4-D Treatments Material | ppm. | Remarks in fall of 1946 | Station |
|---|---|---|---|---|---|---|---|
| Sumac | 5 ft. | 1945 | Summer | $NH_4$ salt | 1000 | Mostly killed | Minn. |
| " | " | " | " | Ester | 1000 | Killed | " |
| " | " | " | " | 5% Na salt dust | -- | Killed | " |
| " | Large | 1945 | Summer | Na salt | 1000 | Killed | Kansas |
| " | Small | " | " | Ester | -- | Killed | " |
| " | 5 to 7 ft. | 1946 | Spring | Na salt | 1500 | Mostly killed, some regrowth | " |
| " | " | | " | $NH_4$ salt | 1500 | Mostly killed, some regrowth | " |
| " | " | | " | Amine salt | 1500 | Mostly killed, some regrowth | " |
| " | " | | " | Ester | 1500 | Mostly killed, slight regrowth | " |
| Willows | | 1945 | --- | All preps. | All rates | Great variability in kill | Minn. |

The data shows that applications of 2,4-D to woody shrubs and trees in the spring just after they have completely leafed out will result in better kills than if the applications are delayed until summer or fall. Seedlings, small shrubs and suckers from stumps of many species seem to be killed more easily than more mature trees. In general, growths more than 6 to 8 feet in height when treated gave considerably poorer kills than that obtained with smaller shrubs. Large trees were only partially killed in all cases even though all leaves were killed by the initial treatment.

The use of 2,4-D to kill certain woody shrubs and trees appears promising. Further experience may show that it can be used to advantage in controlling and perhaps eradicating brushy growth in power line, railroad, and highway rights of way, irrigation ditches, pastures and recreation areas.

Mr. Timmons: Thank you Dr. Buchholtz. I wish that .. Mr. Keith Barrons of the Dow Chemical Company would give us some of his results.

Mr. Barrons. The thing I am curious of is that we have a lot yet to learn in cooperation with the power companies on weed control. Three-quarters of a million has been used in cutting down brush this past year. We seem to obtain our best results when we spray rather new growth. The best thing is to cut it off and spray the ground. The scheme for application not to leaves but to stumps. Kerosene may be applied by insect sprayer or by some other means of application. Just enough to wet freshly cut stump and absorb 2,4-D into tissues. Promising results along that line.

Mr. Melander. I agree with the statement made by Dr. Barrons of the Dow Chemical Co. regarding the treatment of applying chemicals to cut surfaces. In eradicating barberry plants, applying ammate in solution as a foliage spray, we obtain a burning of the leaves but did not get a sufficient translation of the chemical to the roots to effect a kill. However, when we cut off the brush at the surface of the ground applying ammate solutions to the cut surface, we obtained a very good kill with no subsequent spraying we have tried applying 2,4-D to cut surfaces but our results are not collective to date. Applying foliage sprays of 2,4-D to the barberry proved not to be effective in getting a kill. It is our assumption that the waxey nature of the surface of the leaves does not give sufficient absorption of the chemical to the roots to effect a kill. This also applied to other plants that have resistant spray solution of 2,4-D. It is our opinion that probably these could be killed by applying canned 2,4-D solution to the cut surfaces of woody plants. I cannot agree with Dr. Buchholtz that woody plant eradication is not of particularly economical importance when you take into consideration the amount of pasture space occupied by useless shrubs. The tremendous cost to power companies to keep brush clear from their right-of-ways as well as the tremendous expense involved in clearing right aways and dredge ditches. I am sure that there are many in this audience that have a distinct interest in one of these phases of eradicating woody plants. I, therefore, would like to recommend to the program committee at our next meeting that arrangements be made for summaries of work done in killing woody plants with herbicides.

Mr. Manske: Brush was cut down early in 1945 and sprayed the cut surfaces with very little results. Quite healthy and it came up again. It was sprayed at least four times in 45 and this year it continued to come up at about same rate. Haven't killed them yet and I doubt if we will next year. I do not recommend cutting brush before you spray them. Young plants or stumps are most acceptable to this spraying.

Mr. Timmons. I believe we should proceed to the next topic. Dr. Willard.

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## TREATMENT OF BROADLEAVED LAWN WEEDS WITH 2,4-D.

C. J. Willard and E. D. Witman.

The reports this year referred almost exclusively to dandelion, and such other broadleaved weeds as occurred with the dandelions were included with them in the reports. Unfortunately, the data from Mr. Hanson and Mr. Zahnley were not obtained in time to mimeograph them for distribution at Des Moines but they appear in this report. In addition to the men whose data is given in the tables, Ralph R. Thomas of Pampa, Texas, and W. H. Minshall of Ottawa, Ontario, furnished data on dandelions.

The results are very similar to last year in that much poorer results were obtained in Kansas and Nebraska than further north and east. It is also clear from some of the Kansas-Nebraska results that growing conditions were responsible for this difference in behavior, since some very good results were obtained in that region under favorable growing conditions.

Except in Kansas and Nebraska, and under favorable conditions even there, the 0.05% solution gave remarkably good kills. In many instances, it is questionable if a stronger dose is required. Only under dry and very unfavorable conditions were concentrations greater than 1,000 parts per million for dandelions justified by the results.

Under favorable conditions there was no essential difference between materials. Under unfavorable conditions the esters were decidedly more effective than the salts, whether sodium, ammonium or triethanolamine.

The best time to use 2,4-D on a lawn is considerably a matter of lawn management, but it is very evident from this series of experiments that for best kills, the weeds should be actively growing. There is no reason to avoid the early stages before dandelion bloom, if it is convenient to work at that time. The psychologically best time to treat dandelions is when they are in bloom, and that is also a generally effective time. It does open up the lawn to crabgrass where that is a problem. From the point of view of crabgrass invasion, the early fall is an excellent time to treat if the weeds are vigorously growing.

We question the necessity of continuing tests of this type with dandelions for another year. What is needed now in the field of lawn weeds is studies of methods of application, of the best interrelation between the use of 2,4-D and other maintenance operations, the development of other chemicals which may effect other weeds, especially crabgrass, and a multitude of similar special problems.

Experiments on the treatment of lawn weeds with 2,4-D is shown on the table following. Those contributing are the following: H. E. Woods, Morden, Canada, C. J. Willard, Columbus, Ohio, V. F. Bruns, Canton, Kansas, F. W. Bailey, Fredericton, N. B., Canada, L. V. Sherwood, Urbana, Illinois, F. L. Timmons, Hays, Kansas, Oliver C. Lee, Lafayette, Indiana, Noel S. Hanson, Lincoln, Nebraska, and J. W. Zahnley, Manhattan, Kansas.

| Investigator | Material | Type | Date | Pct. kill of broadleaved lawn weeds, mostly dandelions | | | |
|---|---|---|---|---|---|---|---|
| | | | | 500 ppm. | 1000 ppm. | 1500 ppm. | 2000 ppm. |
| North and East. A. Very Early Spring - before dandelion bloom | | | | | | | |
| 1 | Tufor | Amine salt | May 7 | 92 | 99 | 98 | 92 |
| 2 | Tufor | Amine salt | April 2 | 88 | 98 | 99 | 97 |
| 2 | Tufor | Amine salt | April 20 | 92 | 98 | 98 | 99 |
| 1 | Weedone | Ethyl ester | May 7 | 97 | 98 | 98 | 98 |
| 2 | Weedone | Ethyl ester | April 20 | 98 | 97 | 93 | 99 |
| 1 | Dow G-654 | Methyl ester | May 7 | 99 | 100 | 99 | 96 |
| 4 | Dow G-654 | Methyl ester | May 20 | 90 | 91 | 96 | 90 |
| 2 | Weed-no-More | Butyl ester | April 2 | 97 | 99 | 98 | 99 |
| 2 | Weed-no-More | Butyl ester | April 20 | 98 | 97 | 93 | 99 |
| 1 | 2,4-Dow | Sodium salt | May 7 | 76 | 95 | 96 | 24 |
| 2 | 2,4-Dow | Sodium salt | April 2 | 93 | 92 | 74 | 86 |
| 2 | 2,4-Dow | Sodium salt | April 20 | 92 | 93 | 96 | 98 |
| 4 | 2,4-Dow | Sodium salt | May 20 | 91 | 96 | 99 | 97 |
| Kansas and Nebraska. A. Very Early Spring | | | | | | | |
| 3 | Dow A 136 | Amine salt | March 29 | | 100 | | |
| 8 | Weed-Tox | Amine salt | April 5 | 93 | 97 | 98 | 95 |
| 3 | Weedone | Ethyl ester | March 29 | | 98 | | |
| 3 | Sherwin-Williams | Ethyl ester | March 29 | | 100 | | |
| 6 | Weedone | Ethyl ester | March 27 | 61 | 72 | 93 | 89 |
| 9 | Weedone | Ethyl ester | March 21 | | 99 | | |
| 3 | Slazweed | Sodium salt | March 29 | | 95 | | |
| 6 | Chipman's | Sodium salt | March 27 | 64 | | 63 | 80 |
| 8 | 2,4-Dow | Sodium salt | April 5 | 83 | 88 | 98 | 98 |
| 9 | Dow 510 | Sodium salt | March 21 | 82 | 90 | 17 | |
| 9 | Chipman's | Sodium salt | March 21 | | 89 | | |
| 8 | Weed-No-More | Butyl ester | April 5 | 84 | 90 | 94 | 97 |
| 9 | Weed-No-More | Butyl ester | March 21 | | 99 | | |
| 9 | Weedanol | Acid | March 21 | | 93 | | |
| North and East B and C Early and Late Spring | | | | | | | |
| 2 | Tufor | Amine salt | May 23 | 88 | 100 | 82 | 100 |
| 2 | Tufor | Amine salt | June 3 | 96 | 99 | 99 | 100 |
| 1 | Tufor | Amine salt | May 29 | 91 | 92 | 90 | 91 |
| 1 | Tufor | Amine salt | May 30 | | | 60 | |
| 1 | Tufor | Amine salt | May 29 | | 88 | | |

| Investigator | Material | | | Pct. kill of broadleaved lawn weeds, mostly dandelions | | | |
|---|---|---|---|---|---|---|---|
| | | | | 500 ppm. | 1000 ppm. | 1500 ppm. | 2000 ppm. |
| 1 | Dow A-536 | Amine Salt | May 22 | 95 | 98 | 100 | 100 |
| 1 | Dow A-536 | Amine salt | May 29 | | 75 | | |
| 1 | Dow A-536 | Amine salt | June 5 | 95 | 98 | 95 | 98 |
| 1 | Stantox | Amine salt | May 21 | 80 | 95 | 60 | 85 |
| 1 | Stantox | Amine salt | May 29 | | 88 | | |
| 1 | Stantox | Amine salt | June 4 | 80 | 85 | 80 | 90 |
| 1 | Weed-Tox | Amine salt | May 21 | 40 | 60 | 40 | 40 |
| 1 | Weed-Tox | Amine salt | May 29 | | 20 | | |
| 1 | Weed-Tox | Amine salt | June 4 | 50 | 40 | 40 | 85 |
| 1 | Standag | Amine salt | May 29 | | 45 | | |
| 1 | D-Weed | Amine salt | May 29 | | 55 | | |
| 1 | Herbate | Amm. salt | May 21 | 75 | 90 | 90 | 50 |
| 1 | Herbate | Amm. salt | May 29 | | 60 | | |
| 1 | Herbate | Amm. salt | June 4 | 85 | 90 | 80 | 85 |
| 1 | Chipman's | Sodium salt | May 22 | 90 | 98 | 100 | 100 |
| 1 | Chipman's | Sodium salt | May 29 | | 99 | | |
| 1 | Chipman's | Sodium salt | May 30 | | | 40 | |
| 1 | Chipman's | Sodium salt | June 5 | 90 | 96 | 100 | 100 |
| 1 | 2,4 Dow | Sodium salt | May 29 | 87 | 90 | 92 | 95 |
| 7 | 2,4-Dow | Sodium salt | May 1 | 86 | 98 | 94 | |
| 2 | 2,4-Dow | Sodium salt | May 23 | 88 | 98 | 98 | 100 |
| 2 | 2,4-Dow | Sodium salt | June 3 | 99 | 100 | 99 | 100 |
| 4 | 2,4-Dow | Sodium salt | June 17 | 90 | 81 | 92 | 83 |
| 5 | Baker's | Sodium salt | May 14 | 100 | 100 | 96 | 100 |
| 1 | Baker's | Sodium salt | May 29 | | 60 | | |
| 1 | DeWeed | Sodium salt | May 29 | | 98 | | |
| 1 | Weed-Tox | Sodium salt | May 29 | | 95 | | |
| 1 | Stantox | Sodium salt | May 29 | | 35 | | |
| 1 | Slazweed | Sodium salt | May 29 | | 85 | | |
| 5 | DeWeed #3 | Acid | April 30 | 76 | 91 | | |
| 5 | DeWeed #3 | Acid | May 14 | 95 | 100 | 100 | 100 |
| 1 | Weedanol | Acid | May 22 | 95 | 95 | 98 | 100 |
| 1 | Weedanol | Acid | May 29 | | 40 | | |
| 1 | Weedanol | Acid | June 5 | 93 | 98 | 100 | 100 |

| Investigator | Material | Type | Date | Pct. kill of broadleaved lawn weeds, mostly dandelions | | | |
|---|---|---|---|---|---|---|---|
| | | | | 500 ppm. | 1000 ppm. | 1500 ppm. | 2000 ppm. |
| North and East B and C | | Early and Late Spring | | | | | |
| 1 | Dow G-654 | Methyl ester | May 29 | 94 | 96 | 95 | 93 |
| 4 | Dow G-654 | Methyl ester | June 17 | 85 | 80 | 95 | 96 |
| 1 | Weed-No-More | Butyl ester | May 22 | 95 | 100 | 95 | 100 |
| 2 | Weed-No-More | Butyl ester | May 23 | 99 | 100 | 90 | 99 |
| 2 | Weed-No-More | Butyl ester | June 3 | 84 | 99 | 100 | 100 |
| 1 | Weed-No-More | Butyl ester | May 21 | 85 | 95 | 85 | 85 |
| 1 | Weed-No-More | Butyl ester | May 30 | | | 100 | |
| 1 | Weed-No-More | Butyl ester | May 29 | | 98 | | |
| 1 | Weed-No-More | Butyl ester | June 4 | 85 | 85 | 90 | 90 |
| 1 | Weed-No-More | Butyl ester | June 5 | 94 | 98 | 100 | 100 |
| 2 | Weedone | Ethyl ester | May 23 | 98 | 99 | 100 | 100 |
| 2 | Weedone | Ethyl ester | June 3 | 96 | 96 | 100 | 99 |
| 1 | Weedone | Ethyl ester | May 29 | 89 | 93 | 95 | 96 |
| 1 | Weedone | Ethyl ester | May 30 | | | 100 | |
| Kansas and Nebraska. B & C. Early and Late Spring | | | | | | | |
| 6 | Stantox | Amine salt | April 16 | 80 | 84 | 82 | 94 |
| 8 | Tufor | Amine salt | April 23 | 99 | 98 | 100 | 100 |
| 8 | Tufor | Amine salt | May 27 | 93 | 88 | 94 | 90 |
| 9 | Tufor | Amine salt | May 18 | | 5 | 7 | |
| 9 | Dow Weed Killer | Amine | May 18 | | 3 | 7 | |
| 9 | Dow | Amine | May 23 | | 40 | | |
| 6 | Weedone | Ethyl ester | April 16 | 72 | 88 | 95 | 97 |
| 9 | Weedone | Ethyl ester | May 18 | | 40 | 52 | |
| 9 | Weedone | Ethyl ester | May 23 | | 70 | | |
| 6 | Chipman's | Sodium salt | April 16 | 54 | 61 | 63 | 85 |
| 8 | 2,4-Dow | Sodium salt | April 22 | 99 | 99 | 100 | 99 |
| 8 | 2,4-Dow | Sodium salt | May 27 | 83 | 84 | 89 | 92 |
| 9 | Dow 510 | Sodium salt | May 18 | | 10 | 11 | |
| 6 | Weed-No-More | Butyl ester | April 16 | 77 | 92 | 91 | 87 |
| 8 | Weed-No-More | Butyl ester | April 22 | 96 | 99 | 100 | 100 |
| 8 | Weed-No-More | Butyl ester | May 27 | 89 | 97 | 99 | 98 |
| 9 | Weed-No-More | Butyl ester | May 18 | | 90 | 82 | |
| 9 | Weed-No-More | Butyl ester | May 23 | | 70 | | |
| 9 | Dow G-652 | Methyl ester | May 18 | | 97 | 98 | |

| Investigator | Material | Type | Date | Pct. kill of broadleaved lawn weeds, mostly dandelions | | | |
|---|---|---|---|---|---|---|---|
| | | | | 500 ppm. | 1000 ppm. | 1500 ppm. | 2000 ppm. |
| 9 | DuPont | Methoxone | May 18 | | 20 | 17 | |
| 9 | DuPont | $NH_4$ salt | May 18 | | 7 | | |
| 9 | DuPont | $NH_4$ salt | May 23 | | 45 | | |
| North and East D. Midsummer | | | | | | | |
| 2 | Tufor | Amine salt | June 19 | | | 100 | 100 |
| 1 | Tufor | Amine salt | June 25 | 89 | 100 | 96 | 95 |
| 2 | Tufor | Amine salt | June 26 | | 100 | 100 | 100 |
| 1 | Tufor | Amine salt | July 29 | 89 | 96 | 99 | 98 |
| 1 | Stantox | Amine salt | July 16 | 80 | 85 | 95 | 98 |
| 1 | Dow #-536 | Amine salt | July 16 | 97 | 100 | 97 | 100 |
| 5 | Conc. #6 | Amine salt | June 17 | | 100 | 100 | 100 |
| 5 | Karmex | Amm. salt | June 17 | | 93 | 100 | 100 |
| 1 | Herbate | Amm. salt | July 16 | 90 | 80 | 90 | 98 |
| 7 | 2,4-Dow | Sodium salt | July 3 | 89 | 84 | 90 | |
| 2 | 2,4-Dow | Sodium salt | June 19 | | | 100 | 100 |
| 2 | 2,4-Dow | Sodium salt | June 26 | | 100 | 100 | 100 |
| 1 | 2,4-Dow | Sodium salt | June 25 | 67 | 90 | 94 | 99 |
| 1 | 2,4-Dow | Sodium salt | July 29 | 96 | 99 | 98 | 98 |
| 5 | Chipman's | Sodium salt | June 17 | | 92 | 100 | 100 |
| 1 | Chipman's | Sodium salt | July 17 | 100 | 97 | 99 | 100 |
| 5 | Dow G-654 | Methyl ester | June 17 | | 100 | 100 | 100 |
| 1 | Dow G-654 | Methyl ester | June 25 | 88 | 89 | 96 | 96 |
| 1 | Dow G-654 | Methyl ester | July 29 | 82 | 96 | 99 | 100 |
| 2 | Weedone | Ethyl ester | June 19 | | | 100 | 100 |
| 2 | Weedone | Ethyl ester | June 26 | | 100 | 100 | 100 |
| 1 | Weedone | Ethyl ester | June 25 | 87 | 92 | 90 | 99 |
| 1 | Weedone | Ethyl ester | July 29 | 82 | 96 | 100 | 99 |
| 2 | Weed-No-More | Butyl ester | June 19 | | | 100 | 100 |
| 2 | Weed-No-More | Butyl ester | June 26 | | 100 | 100 | 100 |
| 5 | Weed-No-More | Butyl ester | June 17 | | 100 | 100 | 100 |
| 1 | Weed-No-More | Butyl ester | July 16 | 90 | 90 | 95 | 98 |
| 1 | Weed-No-More | Butyl ester | July 17 | 100 | 100 | 98 | 100 |
| 1 | Weedanol | Acid | July 16 | 80 | 90 | 95 | 98 |
| 1 | Weedanol | Acid | July 17 | 100 | 99 | 100 | 99 |

| Investigator | Material | Type | Date | Pct. kill of broadleaved lawn weeds, mostly dandelions | | | |
|---|---|---|---|---|---|---|---|
| | | | | 500 ppm. | 1000 ppm. | 1500 ppm. | 2000 ppm. |
| Kansas and Nebraska D -Midsummer | | | | | | | |
| 8 | Tufor | Amine salt | Aug. 6 | 86 | 88 | 84 | 64 |
| 8 | 2,4-Dow | Sodium salt | Aug. 6 | 83 | 87 | 93 | 87 |
| 8 | Weed-No-More | Butyl ester | Aug. 6 | 88 | 84 | 86 | 97 |
| North and East. E. Early Fall | | | | | | | |
| 5 | Weed-No-More | Butyl ester | Sept. 21 | | | 68 | |
| 7 | 2,4-Dow | Sodium salt | Sept. 27 | 96 | 98 | 99 | |
| Kansas and Nebraska E. Early Fall | | | | | | | |
| 3 | Dow A-536 | Amine salt | Sept. 10 | | 97 | | |
| 3 | Chipman's | Sodium salt | Sept. 10 | | 87 | | |
| 3 | Karmex | Amm salt | Sept. 10 | | 92 | | |
| 3 | Dow G-654 | Methyl ester | Sept. 10 | | 99 | | |
| 3 | Weedone | Ethyl ester | Sept. 10 | | 99 | | |
| 3 | Weed-No-More | Butyl ester | Sept. 10 | | 99 | | |
| 3 | Weedex | | Sept. 10 | | 99 | | |
| 3 | Methoxone | | Sept. 10 | | 80 | | |
| 3 | N-phenyl Isopropyl carbamate | | Sept. 10 | | 50 | | |

Mr. Timmons. Thank you Dr. Willard. Before we open for discussion on lawn weeds, questions or contributions, is Dr. Witman here. He is among the better looking members of the Panel and was to modest to demonstrate the fact. Does someone have some contributions or questions on Lawn Weeds?

Mr. Hoffman. We have had experience in repeated application with fairly low concentrations on bind weed and Canada thistle . One plot of Canada Thistle sprayed right after another and was completely killed. In this case, it happened within 24 hours. The same plot observed 3 months later and still no weeds.

Dr. Bakke. Three months after treatment is not long enough to determine.

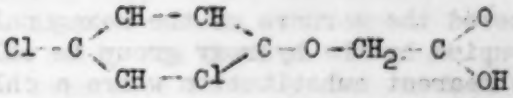
Mr. Knowles. I am somewhat surprised that Canada Thistle is so difficult to kill down here when it is so easy to kill-the country from where it gets its name. Last year at Ottawa, this experiment was conducted on pasture. First treatment, we got very nice kill Six weeks later, there was considerable re-growth. The blanket treatment was given over a series of plots. One year after there was scarcely a Canada Thistle to be seen on any of these plots. We were asked to go ahead and spray entire field because it was so satisfactory.

Mr. Timmons.. Thank you Mr. Knowles. For our next member of the panel, Mr. Witman. He is compelled to give us a discussion on the given strengths of 2,4-D. I believe we would appreciate getting a little more of a low down on that subject.

## SOME CHEMISTRY OF 2,4-D WEED KILLERS

E. D. Witman
Sherwin-Williams Research Associate
The Ohio State University Research Foundation

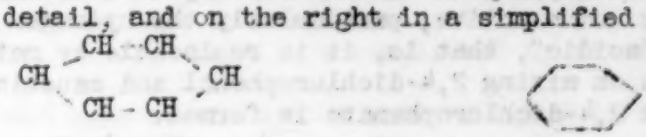
Among the many chemical compounds known to show plant growth regulatory properties, one in particular seems to stand out as important as an herbicide. Its specific name is 2,4 dichlorophenoxyacetic acid. Its structural formula is shown below:



2,4-dichlorophenoxyacetic acid

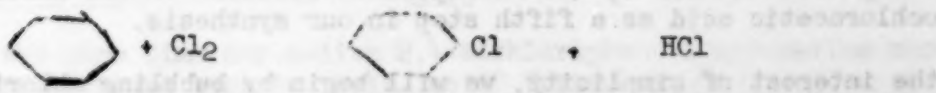
There are a number of ways in which this substance may be synthesized, but in order to avoid a great deal of technicality, I would like to present only the following. From the steps of this synthesis, I hope you will be able to get a better understanding of the chemistry of 2,4-D.

Let us begin our synthesis by recovering benzene from the distillate of coal tar. Benzene is structurally (pictorially) represented by the chemist as being composed of six CH groups linked into a ring with alternate single and double bonds so that each carbon shows four valence bonds and each hydrogen shows one. Benzene is called an aromatic hydrocarbon. It is shown below on the left in detail, and on the right in a simplified form.



Benzene Benzene

The next step in the synthesis is to bubble a regulated amount of chlorine gas into the benzene. This reaction produces monochlorobenzene and hydrogen chl chloride gas. Any excess chlorine produces dichlorobenzenes, trichlorobenzenes, etc.



Benzene Chlorine Monochlorobenzene Hydrogen Chloride

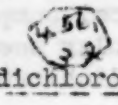
One of the hydrogens of the original benzene has combined with one of the chlorine atoms while the other chlorine atom replaces the lost hydrogen.

A third step in our synthesis requires that we hydrolyze (react with water) chlorobenzene. This step is carried out in very complicated chemical machinery and the resulting product is phenol, our well-known carbolic acid, as shown below:

Cl + $H_2O$ =
OH + HCl

Monochlorobenzene water — Phenol — Hydrogen chloride

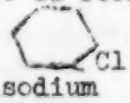
As a fourth step in our synthesis, we shall bubble chlorine through molten phenol under regulated conditions to produce 2,4-dichlorophenol. Some other chlorinated phenols are also formed but only in small amounts.

OH + $2Cl_2$ = Cl 
OH + 2 HCl

Phenol — Chlorine — 2,4-dichlorophenol — Hydrogen chloride

Please note that I have numbered the corners of the hexagonal figure in the dichlorophenol. The position occupied by the hydroxy group is called number one and numbering proceeds toward the nearest substitution where a chlorine atom occupies position number two, number three is blank (occupied by h rogen), a second chlorine occupies position number four, and numbers five and six are blank. Thus, when one says "2,4-dichlorophenol", it is specifically meant that in the number one position of a benzene ring, an hydroxy group occurs and in the two and the four positions, chlorines are present. If further chlorination had been carried out, other chlorophenols would have been produced. For example, 2,4,5-trichlorophenol and on up to pentachlorophenol. If less chlorine had been introduced, we would have formed such compounds as 2-chlorophenol and 4-chlorophenol. Incidentally, these may also be called ortho-chlorophenol and para-chlorophenol resp.

The chlorophenols are all odiferous substances and range from liquids (in the cases of monochlorophenols) to solids. The chlorine atoms on these substances are relatively inert chemically and are not easily replaced or removed. The hydroxy group, however, is quite active; particularly the hydrogen of the hydroxy group. This hydrogen is "acidic", that is, it is replacable by metallic ions such as sodium, etc. Thus on mixing 2,4-dichlorophenol and caustic soda solution, heat is evolved and sodium 2,4-dichlorophenate is formed.

Cl
OH + NaOH = Cl 
ONa + $H_2O$

2,4-dichlorophenol — caustic soda — sodium 2,4-dichlorophenate — water

Let us put our sodium 2,4-dichlorophenate solution on the shelf and proceed to make monochloracetic acid as a fifth step in our synthesis.

In the interest of simplicity, we will begin by bubbling chlorine gas into acetic acid as shown below:

$CH_3C(=O)OH$ + $Cl_2$ = $Cl\text{-}CH_2C(=O)OH$ + HCl

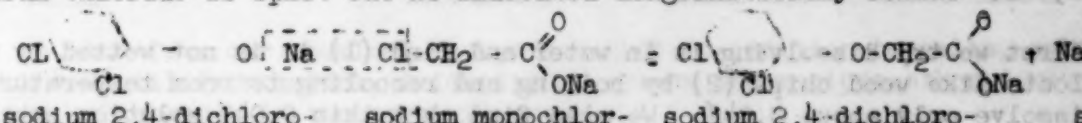
acetic acid — chlorine — monochloracetic acid — hydrogen chloride

forming the required monochloroacetic acid andagain, hydrogen chloride gas. The chlorine in monochloroacetic acid is somewhat more reactive than the chlorines in the above discussed chlorophenols. The $-CH_2-$ group of monochloroacetic acid is relatively stable, chemically. But the carboxyl group, the $-C$ group, is very reactive, especially the hydrogen which is again "acidic" as in the chlorophenols, but even more so. Thus on adding monochloracetic acid to caustic soda solution, heat is evolved and sodium monochloroacetate is formed.

$$Cl\text{-}CH_2\text{-}C(=O)(OH) + NaOH = Cl\text{-}CH_2\text{-}C(=O)(ONa) + H_2O$$

monochloroacetic acid — caustic soda — Sodium monochloroacetate — water

As a sixth step in our synthesis, let us mix the solution of the sodium salt of 2,4-dichlorophenol with the solution of the sodium salt of monochloroacetic acid, and heat the mixture. As the reaction proceeds, a white precipitate separates from the solution. It is the sodium salt of 2,4-D. Sodium chloride is split out as indicated diagramatically below.

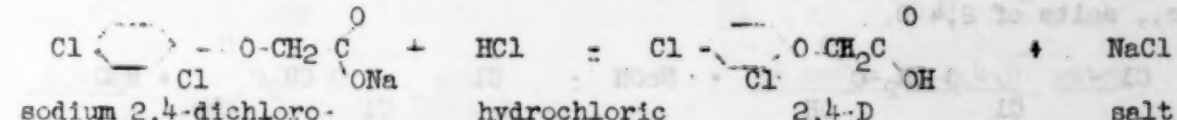


sodium 2,4-dichlorophenate — sodium monochloroacetate — sodium 2,4-dichlorophenoxy acetate — salt

Although the sodium salt of 2,4-D is soluble in water, it separates during a commercial preparation because the concentrations of chemicals employed is so high - also the presence of the salt formed in the reaction lowers the solubility of the sodium salt of 2,4-D.

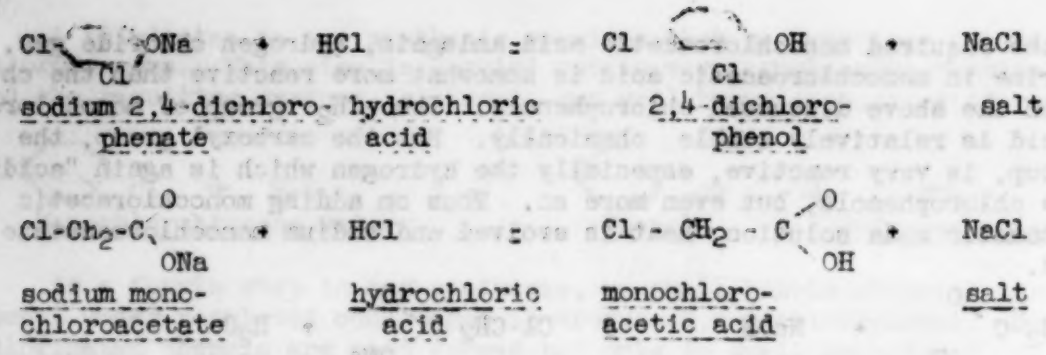
The seventh step in the preparation of 2,4-D requires that we separate the solid sodium salt from the mother liquor (which contains unreacted chemicals, salt, etc.). This is accomplished by filtering.

The wet cake of the sodium salt of 2,4-D is then treated with an acid such as hydrochloric acid to change the sodium salt of 2,4-D to 2,4-D itself.



sodium 2,4-dichlorophenoxy acetate — hydrochloric acid — 2,4-D — salt

At the same time any sodium 2,4-dichlorophenate and sodium monochloroacetate are changed back to their "acid" forms.



sodium 2,4-dichlorophenate + hydrochloric acid = 2,4-dichlorophenol + salt

sodium monochloroacetate + hydrochloric acid = monochloroacetic acid + salt

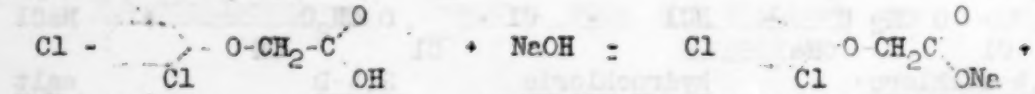
Steam is then blown through the hot acidic mixture which causes any 2,4-dichlorophenol to volatilize and pass off. The residue, which contains 2,4-D as a solid in suspension, and various impurities in solution in water, is filtered, washed and dried. It is now commercial 2,4-D.

After having made 2,4-D, we want to use it as an herbicide. For brevity, let us say we want a solution, suspension, emulsion, etc., containing about 0.1% 2,4-D.

First we try dissolving it in water and find (1) it is not wetted by water but floats like wood chips (2) by boiling and recooling to room temperature we can dissolve only about 0.04%. We also find that this 0.04% solution separates crystals if subjected to lower temperatures.

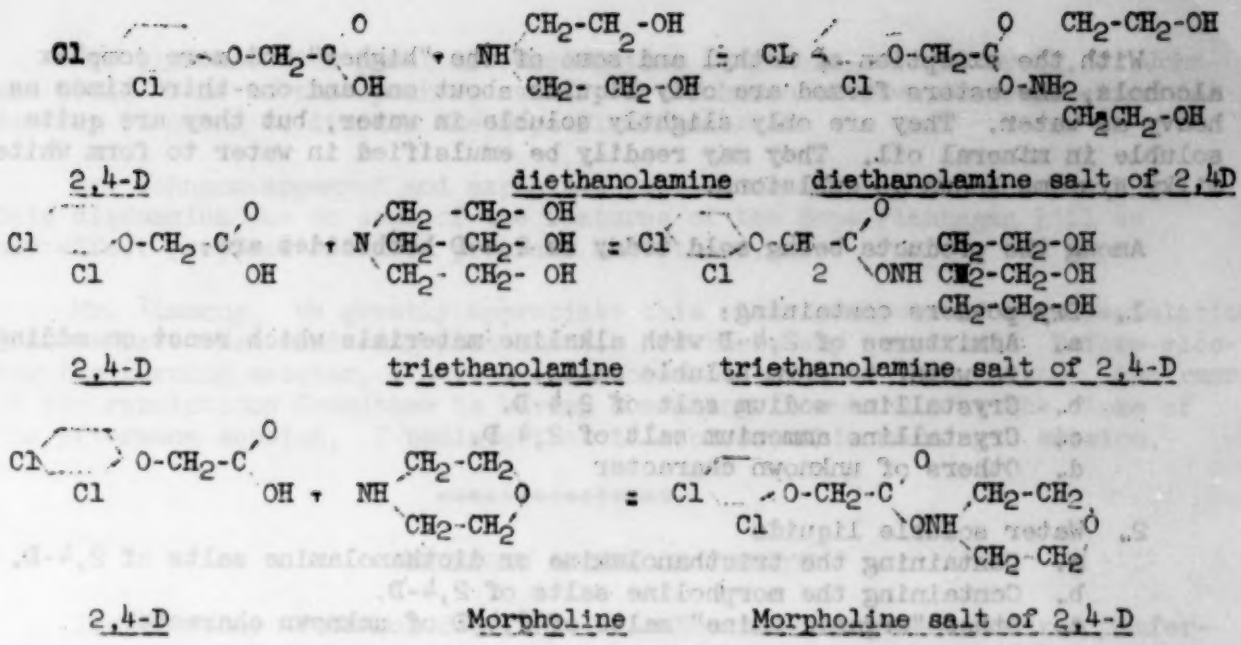
Next, we try dissolving it in alcohol. It is quite soluble, but when we dilute a concentrated alcoholic solution with water, we find again we are limited to about 0.04% in solution. Next, we try Carbowax (which is a kind of an alcohol), and we find the same limitations except that the separation of the insoluble phase of it is somewhat slower. We next try dissolving 2,4-D in mineral oil but again find it is only slightly soluble. If it had been soluble, we could have produced an emulsion.

Turning to our knowledge of chemistry, we try dissolving 2,4-D in dilute caustic soda, dilute ammonia, lime water, and find that these dilute alkalies all allow us to make a solution such as we want for herbicide purposes. Actually, a chemical reaction has occurred and we have made the sodium, ammonium, calcium, etc., salts of 2,4-D.



2,4-D + caustic soda = Sodium salt of 2,4 D + Water

After our success with the above inorganic alkalies, we try some organic alkalies -- such as diethanolamine, triethanolamine, morpholine, etc. They all work well, dissolving large quantities of 2,4-D. The substances formed are shown below. They may be regarded as "amine salts" of 2,4-D.



2,4-D diethanolamine diethanolamine salt of 2,4D



2,4-D triethanolamine triethanolamine salt of 2,4-D

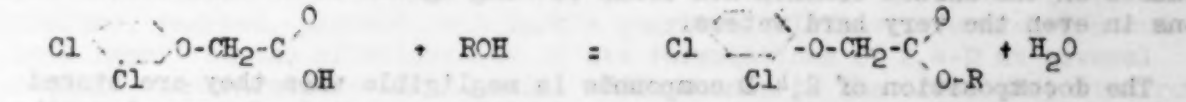


2,4-D Morpholine Morpholine salt of 2,4-D

We know from our chemical background that in addition to salts, substances like 2,4-D will form amides, acidhalides esters and various other derivatives, all through changes in the carboxyl group.

We make the amide but find it has characteristics similar to the acid and does not readily lend itself to use as an herbicide because of these characteristics. We make the acidhalides and find they are too unstable. They react with water (with some violence) to regenerate the acid and we are back where we started.

The esters, and there are a large number of them possible, are made by boiling an alcohol with 2,4-D in the presence of a very small amount of a mineral acid such as sulfuricacid. A general reaction is shown below where ROH represents an alcohol.



2,4-D an alcohol an ester of 2,4-D water

If the alcohol is methyl alcohol, R would be replaced by $-CH_3$. Similarly if the alcohol is ethyl, R would be replaced by $-CH_2CH_3$. Isopropyl alcohol is $-CH_2CHOH$. Normal butyl alcohol is $CH_3CH_2CH_2CH_2CH_2OH$ etc., on up to lauryl alcohol and other "higher" alcohols with very long chains of carbon atoms.

With the exception of methyl and some of the "higher" and more complex alcohols, the esters formed are oily liquids about one and one-third times as heavy as water. They are only slightly soluble in water, but they are quite soluble in mineral oil. They may readily be emulsified in water to form white milky systems known as emulsions.

Among the products being sold today as 2,4-D herbicides are:

1. Dry powders containing:
   a. Admixtures of 2,4-D with alkaline materials which react on adding to water to form soluble salts.
   b. Crystalline sodium salt of 2,4-D.
   c. Crystalline ammonium salt of 2,4-D.
   d. Others of unknown character

2. Water soluble liquids
   a. Containing the tricthanolamine or dicthanolamine salts of 2,4-D.
   b. Containing the morpholine salts of 2,4-D.
   c. Other "organic amine" salts of 2,4-D of unknown character.

3. Water mixable liquids.
   a. Containing the methyl ester of 2,4-D in solution in an oily liquid along with an emulsifying agent and other unknown substances.
   b. Same as "3a" except with the ethyl, isopropyl, N-butyl or amyl esters.

The sodium and ammonium salts are offered in solid form principally because they cannot be produced in concentrated liquid forms which will be stable in packaged form. It is not infrequent that hard water (high in calcium compounds) will bring on difficulties in preparing spray solutions of the admixed powders since the calcium reacts with the admixed alkalies,

$$CaSO_4 + Na_2CO_3 : CaCO_3 + Na_2SO_4$$

Too, depending upon the type of emulsifying agent, some of the ester formulations may offer difficulty when diluted with hard water. However, most ester products on the market contain non-ionic wetting agents which form stable emulsions in even the very hard waters.

The decomposition of 2,4-D compounds is negligible when they are stored dry but in soil they are perhaps decomposed within a period of several months.

Mr. Timmons. Than you Dr. Witman. We do have about a minute or two left before the next number on our program this morning, any questions?

Mr. Dunham. Is the decomposition of 2,4-D strictly chemicals or is there part biological in the soil?

Dr. Witman. Quite stable chemically. Must be a biological fact for that brings on decomposition.

Mr. Timmons. Our panel discussion time is at end. Would Dr. I. J. Johnson please come to the speakers stand? Dr. Johnson of Iowa State Experimental Station is going to discuss the Hope-Flannagan Act.

Dr. Johnson appeared and explained provisions of proposed law No. 733 This discussion was on some of the features of the Hope-Flannagan Bill as may effect proposed research programs and others.

Mr. Timmons. We greatly appreciate this clear analysis of this legislation that we have been wondering alot about. Are there any questions? Before closing the morning session, I have an announcement to make. Mr. Keltner, Chairman of the resolutions Committee is having a meeting in room 910 at the close of the afternoon session. I believe that this closes this morning's session.

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## THURSDAY AFTERNOON SESSION

The Thursday Afternoon Session of the North Central Weed Control Conference started at 1:30 P.M. and called to order by Dr. Worzella. (Clyde Bower was not present, therefore, Dr. Worzella was Chairman as well as Moderator).

Dr. Worzella. So far today we have been pretty well on schedule. I hope to do the same this afternoon. First this afternoon, I would like to call on Dr. Stahler from Minnesota, Dr. Stahler.

### USE OF 2-4,D and OTHER SELECTIVE HERBICIDES IN CONTROLLING ANNUAL WEEDS REPORTED IN UNIFORM EXPERIMENTS II OR IV. Summarized by L. M. STAHLER

Reports on Experiments II or IV, covering the reactions of annual weeds to either the 2,4-D or dinitro herbicides were so varied and incomplete as to preculde any tabular summarization of result data. The reported work of the Canadian Provinces of Saskatchewan, Ontario, Nova Scotia and New Brunswick furnished the most complete data received on rates, dates and methods of application of the several formulations of these herbicides on charlock, frenchweed, purslane, ragweed, pigweed, and lamb's quarters. Illinois furnished a complete report on the effectiveness of six formulations of 2,4-D at several standard concentrations on 15 annual weeds common to the area. Reports from the Hays, Kansas station covered three annual weeds in grain. Reports from South Dakota, Minnesota, and North Dakota cover a large number of annual weeds treated with the several selective herbicides at various rates and dates of application and represent the work of the respective Experiment Stations cooperatively with the Bureau of Plant Industry.

The data made available from these sources had been summarized in the form of a check list of annual weeds with the reported reactions to the herbicides tested. This list includes a few biennial and perennial weed species of minor

importance that are perhaps omitted from other reports of the Conference. The list has been organized alphabetically according to the most common name of the reported species; followed by the scientific name of the genus and species as listed in Standarized Plant Names Kelsey, H. P , & Dayton, V. A Standarized Plant Names. J H. McFarland Co Harrisburg, Pa. Second edition - 1942. The reported reaction of each specie and the state or province reporting it, is indicated in the third column of the listing. The symbols following the name of the state or province refer to the reported reaction of the species to 2,4 D treatments based on the reaction of dandelions as a common standard of efficiency in herbicidal action Thus, double plus (++) indicates that the species are more easily killed than dandelion; a single plus symbol (+)indicates that it is at least as readily killed as is dandelion; a minus sign (-), that it is comparatively more tolerant of 2 4-D; and a zero symbol (0), indicates that no reported applications have eliminated the species consistently Reported reaction of the species to the dinitro herbicides special conditions reported as prevailing to obtain indicated results, etc are given in the last column of the listing.

Reports comparing rates or concentrations of several 2,4-D formulations in eliminating any of the annual weeds that are as readily killed as dandelion (those with a ++ or + rating) indicate no marked advantage for the ester or amine salt preparations over the sodium or ammonium salts; show no advantage in the use of more than 3/4 gallons of spray solution per square rod and indicate that a concentration of any formulations of 2 4-D at 750 ppm. is as efficient in eliminating these easy to kill weeds as the higher concentrations tested This is an important consideration, this group includes the mustards, sunflower, cockle bur marsh elder ragweed and several other annual weeds that are considered as serious competitors of cereal crops which can be treated with concentrations of 2 4-D as low as 750 ppm. without serious damage to the crop

Reports on weeds listed here as tolerant or resistant to the action of 2,4-D, show no advantage for the use of concentrations of the standard formulations above 1000 ppm and show no advantage in increasing rates of application beyond 1 gallon of spray solution per square rod On moderately tolerant weeds, the ester formulations are indicated to be slightly more toxic than the amine, sodium or ammonium salts but no reported data indicates that the esters have consistently eliminated any species or annual or biennial weed that proved tolerant of comparable treatments with the other standard formulations.

Reported result data on the use of Sinox (dinitro-ortho-Cresyllate) or Dow Selective Herbicide, (Ammonium dinitro-secondary butyl phenol), as a water spray solution show these products to be less selective in killing action on broad leaved annual weed seedlings than the 2,4-D compounds Temperature and stage of growth of weeds are indicated to be more critical factors in the successful use of the dinitro compounds than with the 2,4-D compounds. Fragmentary reports on the use of the newer concentrated dinitro sprays in oil or an oil-water emulsion indicate that these compounds are

highly efficient killers of annual weeds but are not as selective in their action as are the dinitro water sprays or 2,4-D compounds, which delimits their use to areas or situations where a quick acting contact herbicide of no selectivity is desirable.

Few and incomplete data on the use of the dinitro compounds or the several 2,4-D formulations as dusts, or concentrated sprays applied with atomixing equipment applied by ground driven equipment or by airplane, indicate that results equal to comparable spray treatments could be secured if suitable equipment and methods of application were available to overcome the uneven distribution of material and the hazards of air current drift now prevailing with these new methods of application of selective herbicides.

A CHECK LIST OF WEEDS REPORTED UNDER UNIFORM EXPERIMENTS II OR IV AND THEIR REACTION TO 2,4-D AND OTHER SELECTIVE HERBICIDES IN 1946.

| Most common name. | Scientific name | States or provinces reporting & reaction to 2,4-D treatment |
|---|---|---|
| Annual sow thistle | Sonchus oleraceus. | Minn.+S.D.+N.D.+ |
| Aster | Aster spp. | Minn.0S.D.0 N.D. 0 |
| Bedstraw.(northern) | Gallium boreale | Minn. ++ |
| Beggar's tick. | Bidens spp. | Minn.++S.D.++N.D.++ |
| Blue bur. | Lappula echinata | Manitoba++Minn.++S.D.++N.D.++ |
| Bouncing bet. | Saponaria officinalis | Minn. 0 to- |
| Buffalo bur | Solanum rostratum | S.D. 0 Minn. 0 |
| Bull thistle | Cirsium lanceolatum | Minn.+S.D.+N.D.+ |
| Burdock | Arctium minus | S.D. + Minn. + to - |
| Butterprint(see Indian mallow) | | |
| Buttercup(bitter) | Ranunculus acris | Minn. - to + |
| Carrott (wild) | Daucus carota | Minn. + Ill. - Wisc. + |
| Carpet weed | Mollugo verticillata | Minn. ++ |
| Catchfly | Silene noctiflora | N.D. 0 Minn. 0 |
| " | S. dichotama | S.D. 0 Minn. 0 |
| " | S. latifolia | S.D. 0 Minn. 0 |
| Catnip | Nepeta cataria | S.D. + Minn. + |
| Chick weed(common) | Stellaria media | Minn. + N.D. + |
| " " (northern) | S. borealis | Minn. ++ |
| " " (mouse ear) | Cerastium vulgatum | Minn. +S.D.+N.D.+Ill.+to- |
| Cinquefoil | Potentilla spp. | Ill. + Minn. + S.D. + N.D. + |
| Chicory | Cichorium intybus | Minn. + to - |
| Cockle bur | Xanthium spp. | Manitoba++Minn.++S.D.++N.D.++ |
| Corn cockle | Agrostemma githago | Minn. 0 S. D. 0 |
| Cone flower(prairie) | Ratibida columnaris | N.D. + S.D. + |
| Creeping Charley | Nepeta hederacea | Minn. ++ |
| Dandelion | Taraxacum spp. | Standard as + |
| Dock (pale) | Rumex triangulivalvia | Manitoba + |
| " (yellow-curled) | R. crispus. | Minn. + to-S.D.+to-N.D.+to- |
| " (sheep sorrel) | R. acetosella | Minn.- to 0 |
| Dodder | Cuscuta spp. | Minn. + to - |
| Dragon head mint | Dracocephalum parviflorum | N.D.+ Minn. + to - |
| Ellisia (pea bur) | Ellisia nyctelia | Minn. ++ |
| Evening primrose | Oenotherra niennis | Minn. +N.D. + S.D. + to - |
| False flax (large seeded) | Camelina sativa | Minn.++S.D.++N.D.++ |
| " " (small seeded) | C. microcarpa | Minn.++S.D.++N.D.++ |
| False sunflower | Heliopsis scabra | S.D. + Minn. + |
| Fern | Asplenium spp.Aspidium spp | Minn. 0 0 |
| Figwort | Scrophularia leporella | N.D. + Minn. + S. D. + |
| Five-finger. (see cinquefoil) | | |
| Fleabane | Erigeron annus | N.D. + S.D. + Minn. + |
| " | E. canadensis | N.D. + S.D. + Minn. + Kansas+ |
| " | E. philadelphicus | N.D. + S.D. + Minn. + |
| Flour-of-an-hour. | Hibiscus trionum | Minn.++ |

Reaction to dinitro sprays, stage of growth when most easily killed.
Killed by dinitro sprays when seedlings, 2,4-D at any stage of development.
No kills reported at any rate or concentration of 2,4-D.
Easily eliminated by all 2,4-D - 750 ppm. sufficient.
Killed as readily as common mustard when young by dinitro or 2,4-D sprays.
As above.
Very tolerant to all rates of 2,4-D and all forms.
As above. Even seedlings are tolerant.
Killed by 1000 ppm. all formulations when treated at pre-bud stage.
As above species. Plants beyond bloom stage quite tolerant.

Severly injured by high concentrations of 2,4-D but recovers. Grotesque forms.
Pre-bloom stage. Later stages quite tolerant.
Killed by 2,4-D, 1000 ppm., all stages of growth.
This group of biennials and perennials all tolerant of 2,4-D.
Ditto
Ditto
Killed by 2,4-D, 1000 ppm. all formulations, pre bud to full bloom.
Readily eliminated by 2,4-D, 1000 ppm. but may require retreatment.
Ditto.
Ditto. Dense growth of this specie may protect some lower plants, retreat.
Erect and prostrate species readily eliminated by 1000 ppm. all formulations.
Killed 1000 ppm. sodium salt when just at pre bud - other stages tolerant.
2,4-D, 750 ppm., kills this specie more consistently than standard dinitro.
Very tolerant species.
Pasture sprays of 2,4-D at 1000 ppm. in June give easy elimination.
More readily controlled by 2,4-D than chickweed.

Only one report on this specie.
Reactions at all stages of development vary widely.
Ditto.
Ditto and generally tolerant.
Only one trial reported-indefinite.
Pre bloom stage kills readily with 2,4-D 1000 ppm. Later stages tolerant.
2,4-D as selective spray in cereals at 750 ppm. eliminates. Ditto dinitro.
2,4-D all formulations, 1000 ppm. from rosette stage to early flower stalk stage.
Reacts as mustard. to 2,4-D More tolerant of dinitro sprays than mustard.
Ditto
Easily eliminated by 2,4-D sprays all stages of growth.
Extremely tolerant of 2,4-D; all formulations to 2000 ppm.
A perennial readily eliminated by 2,4-D at 1000 ppm.

Eliminated by dinitro or 2,4-D as seedlings. Tolerance increases with age.
Ditto. Late stages of development kill with 2,4-D is slow but seed development is stopped.
More readily eliminated at all stages of development by 2,4-D than above species.

| Most common name. | Scientific name | States or provinces reporting & reaction to 2,4-D treatment |
|---|---|---|
| Four-o'clock | Allonia nyctogenia | Minn. + N.D.+ S.D. + |
| French weed | Thlaspi arvense | N.D.+-Manit.+-Sask.+-Minn+- |
| Goat"s beard | Tragopogon pratensis | Minn.+-N.D.+-S.D.+-Man.+ |
| Golden rod | Solidago spp. | Minn. 0 S.D. 0 N.D.-to 0 |
| Gourd (wild) | Cucurbita foetidissima | S. D. 0 |
| Goose foot | Chenopodium hybridum | Minn.+ S.D. + N.D. + |
| Ground cherry | Physalis spp. | Minn.0 S.D. 0 N.D. 0 |
| Gumweed | Grindelia squarrosa | Minn+S.D.+N.D.+Sask.+ |
| Heal-all | Prumella vulgaris | N.D.+ S.D.+ Minn.++ |
| Hedge bindweed | Convolvulus sepium | N.D. +-S.D.+-Min.+- |
| Hedge nettle | Galeopsis tetrahit | N.D. + Minn.++ |
| Hemp. | Cannabis sativa | S.D. +- Minn. +- |
| Hemp nettle | Stachys palustris | S.D. + Minn. + |
| Hoary allysum | Berteroa incana | Minn. ++ |
| Horse tail | Equisetum arvense | Minn. + |
| Hound"s tongue | Cynoglossum officinale | Minn. ++ |
| Indian mallow | Abutillon incanum | Minn.++S.D. ++ |
| Jewell weed | Impatiens pallida | Minn. ++ |
| Jimson weed | Datura stramonium | Minn.++ Illinois+ |
| Kochia | Kochia scoparia | N.D. + S.D. + Minn. + |
| Knot weed (prostrate) | Polygonum aviculare | Minn. - S.D. - N.D. - |
| Knot weed (erect) (see also smart weed) | P. erectum | Minn. -S.D.-N.D.- |
| Lamb"s quarters. | Chenopodium album | New Brun.+N.D.+-S.D.+-Sask.+Ill.+ |
| Lead plant | Amorpha canescens | Minn. + N.D. + (Manit.+ |
| Lettuce(prickly) | Lactuca scariola | N.D.+S.D.+Minn.+Sask.+ |
| " (blue-Perennial) | L. pulchella | N.D.+S.D.+Minn+-Sask.+ |
| " (annual) | L. Ludoviciana | Kansas +- |
| Licorice | Glycorrhiza lepidota | Minn.+-S.D.+-N.D.+- |
| Loco weed | Oxytropis lamberti | S.D. + |
| Mallow(door yard-round leaf) | Malva rotundifolia | Sask.+Minn.+N.D.+Ill.+ |
| Marsh elder | see false ragweed | |
| Mayweed (dog fennel) | Anthemis cotula | Minn.++ S.D.+ |
| Morning glory | see hedge bindweed | |
| Milkweed | Asclepias spp. | Ill. 0 Minn.0S.D.0 N.D.0 |
| Mullein | Verbascum thapsus | Minn. 00 |
| Mustard (ball) | Neslia paniculata | Minn.++S.D.++N.D.++ |
| " (hare's ear) | Conringia orient. | N.D. ++ S.D.++ |
| " (Indian) | Brassica juncea | Minn.++N.D.++S.D.++ |
| " (tumbling) | Sisymbrium altissimun | Minn.++S.D.++N.D.++ |
| " (charlock-common) | Brassica arvensis(kaber) | Asabove & Sask.++Manit++N.S.++ |
| " (wormseed-treacle) | Erysimum cheiranthoides | N.D.++S.D.++Minn.++ |
| Nettle (stinging) | Urtica dioica | Minn.+ to ++ |
| " (wood) | Laportia canadensis | Minn. ++ |
| Nightshade | Solanum spp. | Minn. 0 Ill. 0 S.D. ON.D |
| Orache | see saltbush | |
| Ox-eye daisy | Chrysanthemum leucanthemum | Minn. - to 0 |
| Oxalis | Oxalis spp. | S.D.+- N.D. +-Minn+- Ill.+ |

Most common name
Killed by 2,4-D 1000 ppm., rosette to pre-bloom stage-then quite tolerant.
More tolerant of dinitro or 2,4-D sprays. Seed development stopped by 2,4-D.
Reactions at all stages of development erratic.
No kills reported with any concentration of any formulation.
Single reported test indicates this specie to be very tolerant.
More tolerant of dinitro sprays than 2,4-D. Becomes tolerant with age.
Both annual and perennial specie very tolerant of 2,4-D sprays.
Develops tolerance to 2,4-D sprays with age.
Easily eliminated by selective treatment of grain with 2,4-D sprays.
Perennial. More readily controlled by 2,4-D sprays than field bindweed.
Easily eliminated by 2,4-D, 1000 ppm. to bloom stage - then more tolerant.
Reactions erratic.
As hedge nettle.
Annual or biennial easily eliminated by all 2,4-D formulations at 1000 ppm.
Single test of sodium salt 1000 ppm.
Seedlings to pre bloom. More resistant at later stages of growth.
Reacts as annual sunflower.
2,4-D at 750 ppm. all stages of development.
1000 ppm. all formulations.
All formulations at 1000 ppm. when seedling stage. Develops tolerance with age.
Resistant at all stages of development to 2,4-D.
ditto.

Seedlings killed by either 2,4-D or dinitro sprays - develop tolerance with age.
React slowly but kill complete with Sodium salt at 1000 ppm. at bloom stage.
Seedlings killed, 2,4-D 650 ppm. older plants develop tolerance.
A perennial more easily eliminated by 2,4-D than above species.
Reacts as L.scariola.
Very sensitive to 2,4-D sprays.
As preceding species.
Reactions identical 3with those of dandelion.

Develops tolerance with age. Very sensitive when seedling stage.

As tolerant of 2,4-D treatment as any species tested.
Rosette stage 2,4-D at 1000 ppm. slight reaction, nothing at later development.
All mustards listed can be eliminated by all 2,4-D formulations at concentrations of 750 ppm. using 100 gallons or less of solution per square acre
Dinitro sprays eliminate mustards readily but their effect is dependant on proper conditions of growth, temperature and other factors that cannot be controlled.

Generally eliminated by all formulations at 1000 ppm., up to ripe seed stage.
More sensitive to 2,4-D than preceding species.
As tolerant of 2,4-D treatment as the milkweeds.

No reported elimination of the species. Single test indicates high resistance.
Tolerant to resistant in shaded situations.

| | | |
|---|---|---|
| Pepper grass | Lepidium virginicum | Minn.++Ill.++N.D.+S.D.+ |
| Pigweed (rough-redroot) | Amaranthus retroflexus | Sask.+Manitoba+Tex.+-Minn.+ |
| " (tumbling) | A. graecizans | Minn.+S.D.+N.D.+ (S.D.+ |
| " (prostrate) | A. blitoides | Minn.-S.D.-N.D.- |
| Pineapple weed | Matricaria matricaroides | Minn.++Manitoba++ |
| Plantain (common) | Plantago major | Minn.+Ill.+S.D.+Manitoba+ |
| " (blackseeded) | P. rugelli | Minn. +- S.D. +- |
| " (buckhorn) | P. lanceolata | Minn. +- Illinois +- |
| " (Purshii) | P. purshii | Minn. + S.D. + N.D. +- |
| Puncture vine.. | Tribulus terrestris | Texas++Minn.+S.D.++ |
| Purslane | Portulaca oleracea | Manitoba 0 Minn. 0 S.D. 0 |
| Radish (wild) | Raphanus raphanistrum | Minn. ++ |
| Ragweed (common) | Ambrosia artemisiifolia | Manitoba++Minn.++Ill.+N.D.++ S.D.++ |
| Ragweed (giant) | Ambrosia trifida | Sask.++Minn.++S.D.++N.D.++ |
| " (western-perennial | Ambrosia psilostachya | N.D.++S.D.+Minn.++ |
| " (false-marsh elder) | Iva xanthifolia | Manitobia++ N.D.+ S.D.++ |
| Roadside thistle | Cirsium discolor | Minn. + S.D. + |
| Rocket (yellow winter) | Barbarea spp. | Minn.++ S.D. ++ |
| " (purple-dame's) | Hesperis matronalis | Minn.++ |
| Rose | Rosa spp. | Minn. 0 N.D. 0 S.D. 0 |
| Rosin weed. | Silphium spp. | Minn. + |
| Russian thistle | Salsola spp. | Manitoba+N.D.+-S.D.+-Minn.+- |
| Sand bur | Cenchrus spp. | S.D. 0 Minn. 0 |
| Salt bush (orache) | Atriplex hastata | Manitoba ++ |
| " | Atriplex spp. | S.D. + Minn. + N.D. + |
| Scouring rush. See horse tail. | | |
| Shepherds purse | Capsella bursa-pastoris | Ill.-OMinn.-+S.D.+-N.D.+- |
| Skeleton weed. | Lygodesmia juncea | Minn.++S.D.++N.D.++ |
| Smartweed | Polygonum achoreum | Manitoba 0 - |
| " | P. pennsylvanicum | Minn. 0-S.D. 0- |
| " | P. hydropiper | Minn. 0 -. S.D. 0 - |
| " | P. Persicaria | Minn.-+S.D.+-N.D.+-Ill.+- |
| " | | |
| Spurge (prostrate.) | Euphorbia maculata | Ill.+Minn.+-S.D.+-N.D.+- |
| " (cypress) | E. cyperissias | Minn. 0 - |
| " (emarginated) | E. marginata | Minn. 0 - S.D. 0 |
| Stickseed See blue bur. | | |
| Strawberry (wild) | Fragaria spp. | Minn. 0 -. S.D. 0 - |
| Sunflower | Helianthus annuas | S.D.++ N.D.++ Minn.++ |
| " | H. scaberrimus | S.D. + Minn. + |
| " | H. grosseserratus | S.D. ++ Minn. ++ |
| " | H. maximiliani | Minn. + S.D. + |
| " | H. tuberosus | Minn. ++ S.D.++ N.D.++ |
| Sweet clover | Melilotus spp. | S.D. + Minn. + N.D. + |
| Tansy | Tanecetum vulgare | Minn. +- 0. |
| Toad flax | Linaria vulgare | Minn. 0 N.D. 0 |
| Water hemlock | Cicuta maculata | Minn. + |

Sensitive to 2,4-D as seedlings or rosette stage. Develops tolerance later stag
As above species.
Ditto.
Ditto.
Sensitive to 2,4-D all stages. Good kills with conc. of 750 ppm.
All species plantain except buckhorn, reported slightly more tolerant of 2,4-D sprays at comparable rates than dandelion. All develop tolerance after seed set stage. Buckhorn erratic in reaction and no complete elimination reported.

1000 ppm. all formulations have been reported as eliminating this specie.
Very resistant at all stages of development. No reported elimination.
Kills as readily as the mustards with either 2,4-D or dinitro herbicides.
Reacts as mustards to 2,4-D. Only seedlings effectively controlled by dinitro (spray.

As above species.
Reacts as the annual specie to 2,4-D. Dinitro sprays not effective.
Reacts as common ragweed when seedling. Only 2,4-D. controls maturing plants.
Eliminated by sodium salt 1000 ppm. at pre-bloom stage.
Reacts as mustards.
Reacts as mustards.
Resistant. No reported elimination.
Reacts as sunflowers.
Sensitive to 2,4-D when seedling stage-develops tolerance with age.
No reaction to 2,4-D or dinitro sprays.
Sensitive as mustard to 2,4-D when young. Dinitro effective on small seedlings.
Ditto.

Fairly sensitive as seedlings. Develops tolerance when beyond rosette stage.
A perennial easily eliminated by all formulations 2,4-D at 1000 ppm.
This group generally tolerant of all concentrations of 2,4-D and only seedlings are effected by the dinitro sprays. P. persicaria more sensitive than the other reported species and generally is controlled but not eliminated by 2,4-D sprays.

The only reported species of spurge that is eliminated by 2,4-D.
Very tolerant.
Ditto.
Very tolerant

Annual sunflowers are as sensitive to 2,4-D sprays as common mustard. Perennial species reported are very sensitive to 2,4-D and are generally controlled with comparable treatments that will eliminate dandelion.

Seedlings and small second year plants are as readily controlled as dandelions. at comparable rates of treatment with 2,4-D but older plants are tolerant.
Single reported test inconclusive.
Very tolerant.
Eliminated with sodium salt of 1000 ppm.

| | | |
|---|---|---|
| White cockle | Lychnis alba | Minn. O S. D. O |
| Wild buckwheat | Polygonum convolvulus | Ill.- Sask.-Minn.+-N.D.-+S.D.- |
| Wild cucumber | Sicyos angulatus | Minn. ++ |
| Wild parsnip | Pastinaca sylvestra | Minn. + |
| Wild sweet potato | Ipomea spp. | Ill. - Minn. + |
| Wormwood | Artemisia absinthium | Minn. + S.D. +- |
| " | A. ludoviniana | Minn.-+ S.D. + N D.+ |
| Vervain | Verbena spp. | Minn. + S.D. + |
| Vetch | Vicia cracca | Manitoba + |
| " | V. angustifolia | Minn. + S.D. + N.D. + |
| Violet | Viola spp. | Minn. O S.D. O N.D. O |
| Yarrow | Achillea millifolium | Sask.+Manitoba+Minn.OS.D.O |
| Yellow trefoil(black Medic.) | Medicago lupulina | Minn. + S.D. + N.D.+Ill.+ |

Very tolerant
Small seedlings effectively controlled at 1000 ppm, 2,4-D, older plants resistan
Very sensitive.
Eliminated with sodium salt 1000 ppm.
Erratic in two reports.
Woody perennial. Eliminated 1000 ppm. all formulations 2,4-D.
As preceding species.
Eliminated at full bloom, 1000 ppm., sodium salt
Single test reported.
Eliminated with 1000 ppm sodium and ammonium salts.
Very tolerant all 2,4-D sprays.
Reports erratic.
Kills as dandelion or more readily.

Mr. Worzella. Thank you Dr. Stahler. You have heard the brief report on annual weeds, do you have any questions or contributions?

Mr. Zorsch. Is he going to make any remarks about selectivity of 2,4-D. on various small grains and corn at this particular momment.

Dr. Stahler. That subject will be taken up later in various reports.

Mr. Worzella. Is there another question.

Mr. Melander. I understand that you had good results in the dusting. We didn't get as good results with dusting as we were able to get with spray simply because we did not have the equipment. We did not get even distribution. You must have equipment to get good distribution.

Mr. Timmons. In our experimental work using dusts, at first we tried to pick mornings when there was a heavy dew. We got up early and got out in the fields while a heavy dew was still on. We tried going out during the middle of the day under very dry conditions and results were as good as if working with dew. We got practically no kill with sodium salts.

Clair A. Brown. We had very good success in applying 2,4-D by airplane. We have used the compound made from Dow 9510 and we have used sodium salt and got good distribution. (10 pounds per acre). This past season, 3,000 acres of rice were dusted in Louisiana.

Gordon A. Brandes. Have any other materials been used as dust?

Zorst. Yes, there are a multitude of things used. Very little difference unless you take atomized dust.

W. P. MacDonald. What have they done on minimum gallons per acre? We have not done much along that line.

Keith Barrons. The only thing we have done under degree of control was the same amount of 2,4-D per acre in 25, 50 and 100 gallons of water. Just as good results with 25 gallons as on larger volumes Have good results with 25 gallons. If using salt, too small amount of liquid will make too much evaporation, but it is a matter of suitable equipment.

Chester Otis. We have been using volumes per acre. Twelve-fifteen gallons per acre. We have come to the conclusion that 12-15 is better. Sprayed about 10,000 acres of grain all at 12 to 15 gallons per acre. Worked very satisfactorily. The 15 gallon per acre in most cases where humidity was low and better results were obtained than where 10 gallons were used.

Mr. Worzella. Experiment 5 deals with effect of 2,4-D on crops and Dr. Helgeson from the North Dakota Experiment Station will take that up.

Uniform Experiment No V.
Effects of Various 2,4-D Concentrations and Formulations
On Crop Plants. - E. A. Helgeson

According to the plan for this experiment crops were to be treated on weed free land. Relatively few experiments reported were set up according to the plant and therefore the following summary must be regarded as based on insufficient and inconclusive data.

In general, all grain crops treated in early growth stages in fields with 2,4-D concentrations from 1000 ppm. and up were injured Of cereals, corn seemed most sensitive and spring and winter wheat least susceptible. Barley appeared to show more injury than did oats Treatments on oats and barley reduced lodging somewhat. Test weight and germination of grain from treated oats, barley and wheat differed little from checks except in cases where plants showed severe injury as a result of spraying. Sudan grass, kafir and cane showed reduced yeilds of forage in treated plots.

A number of experiments reported were in fields infested with fairly heavy stands of annual or perennial weeds In most of these cases, yields of grain (wheat, oats, barley) were apparently better in sprayed plots than in check plots.

In order of increasing toxicity to cereal plants, 2,4-D formulations used rank as follows: Sodium salt, ammonium salt amines and esters In general, increased concentrations showed corresponding increases in injury.

Mr Worzella. Thank you Dr. Helgeson Now we shall have this discussion open to the audience.

Dr Zorsch During the past summer, we laid out about 100 acre plots to compare the effects of 2,4-D.

Keith Barrons I don't know exactly what I could add except that we found surprising good weed control of annual weeds of many species at much less 2,4-D than I thinkwas used in our uniform plan. I think that if we would convert all of our thinking in terms of pounds of acid per acre, we could better understand talks at these meetings.

Mr. Hoffmann In our own work, we have observed that the use of 2,4-D in one instance reduced a yield of 80 bushels to 30 bushels when applied at one-half pound per acre. In another instance, it resulted in a 50% increased growth when applied at a rate of one and one half pounds per acre The rest of the tests were in between these extremes. Varietal differences, stage of growth, and possibly cultural conditions appear to influence the effect of 2,4-D on corn.

2,4-D may cause the following types of injury on some varieties of corn: increased brittleness of stalk-resulting in wind and cultivator breakage, stunted growth, bowed stalks which may result in difficulty in harvesting, distorted and fasciated brace roots resulting in lodging and in some instances, yellowing

of leaves. In one field, 2,4-D was applied on two single cross varieities. The corn was at the stage of growth where it was beginning to joint. A wind several days after treatment broke off two-thirds of one variety of corn but only an occassional plant was broken off in the other variety. No breakage occurred in untreated corn. The single cross that did not break in the wind was seriously injured. It never grew as well as the checks, remaining stunted throughout the growing season. Brace roots were very distorted. Concentrations of one-half and one pound of 2,4-D were used with no difference in concentration response. This increased brittleness is a serious drawback to the use of 2,4-D on corn until we know more about which varieties are susceptible to breakage, possibly the stage of growth and the cultural conditions may also affect breakage tendencies.

Increased brittleness was also observed in other treated fields where no breakage occurred from winds. In these fields, it was impossible to use mechanical cultivation because the cultivator broke off the corn.

Severe stunting of growth was observed in two fields. In one field, treated corn was about two feet shorter than untreated at tasseling time. In another field, where untreated corn was about five feet tall, treated corn was about four feet. Dosages of one half pound per acre produced these results.

Distorted and fasciated brace roots were the general rule. In some fields this led to considerable lodging. Bowing of the stalk occurred with some varieties but not with others. Where mechanical pickers are used for harvesting, the bowing will be a serious disadvantage. In one group of 25 double cross hybrids only three developed normal brace roots where one pound of 2,4-D was used per acre. Three of the 25 varieities had bowed stalks.

In one experiment a plot of ground was treated with 2,4-D at planting time at two and one-half, five and ten pounds of 2,4-D per acre. When the corn was about thirty five inches tall the entire plot as well as adjacent untreated corn was treated again with one-half pound of 2,4-D per acre. The corn on ground untreated at planting time developed severly distorted brace roots. Whereas, the corn on previously treated ground developed normal brace roots. Apparently the second treatment had very little effect on corn which had previously been treated

) Balanced against these bad effects are several instances where the corn was not affected by 2,4-D sprays. Since in some instances the cultural conditions and growth stage of injured corn were similar to those on the healthy corn the only assumption is that varietal difference play an impo tant past in corn response.

We have also made two observations where corn made better growth where 2,4-D was used. In a greenhouse test one third mg. of 2,4-D per four inch plot of soil increased green weights of corn 40% over untreated corn. 2,4-D was applied to the soil in 50 ml. of water when the corn was emerging. Corn was also stimulated in an outside test this spring at Bethany Conn. where 2,4-D was applied at one and one half pounds per acre when the corn was eight inches high. The treated corn made about fifty % greater growth than the untreated.

Treating corn ground before planting gave promise of being an effective weed control measure without injuring corn too much. In ground infested primarily with mallow, ground cherry and chickweed the weed reduction one month after treatment was as follows:

| | | |
|---|---|---|
| at 8# | of 2,4-D | one weed per 10 square feet |
| at 4# | " " " | " " " " " " |
| at 2# | " " " | 28 weeds per 10 square feet |
| at 1# | " " " | 29 weeds per 10 square feet |
| at 0# | " " " | 278 weeds per 10 square feet. |

At 8# of 2,4-D per acre, corn was injured when plated two weeks after treatment. The one pound rate was safe for corn planted immediately after treatment and the two pound rate was safe for corn planted one week after treatment. In another pre-planting treatment, it was found that foxtail was prevented from growing. Check plots had a heavy growth of foxtail whereas the treated plots were clean. Ground cherry is fairly resistant to this type of treatment.

Mr. Worzella. Thank you Mr Hoffman. I would like to hear from one of our Canada friends, Dr Wood would you give us a report on the effect of 2,4-D on various crops.

Dr H. E Wood. Based on rather limited trials with 2,4-D on growing crops conducted in Manitoba in 1945 and 1946, the following observations are made:

In general little if any damage was noted to crops of wheat, oats, or barley, treated with the four formulations of 2,4-D, at concentrations ranging from 05 to .2%; flax on the other hand was very considerably affected especially above .1% concentration. A 35-acre field of millet very heavily infested, principally with wild mustard, was treated with .05% sodium salt (80 imperial gal per acre) with excellent results. On one mustard infested field of wheat dusted -- 20 pounds 5% 2,4 D dust- a marked yield increase was obtained as compared with the untreated check

Mr. Worzella Thank you Dr. Wood. Now let us go on to Dr. McCall's report from DuPont Company Mr. Bruns was to make this report but he could not be present so he asked Dr. McCall to give this report, Dr. McCall.

## Effect on Crop Plants of Residual 2,4-D in the Soil
### Reported by Dr. G. L. McCall

This summarized report is based upon data received from six different experimental stations throughout the northcentral region Three of the reports on Uniform Experiment VI were received from Canada. Although the result data was somewhat variable, some significant trends are apparent.

In order to study the intensity and duration of the effects on crop plants of residual 2,4-D in the soil from spray applications that would ordinarily be made to control annual or perennial weeds in fields, Uniform Experiment VI was

designed in such a way that the different types of 2 4-D were applied at 1000 ppm. and/or 2000 ppm. at 1½ gallons per square rod on bare soil, either in the spring or in the fall, and the various crops planted or seeded on the treated area at the following intervals: (1) immediately before 2,4-D treatment; (2) 5 days, (3) 15 days, (4) 30 days, (5) 45 days, (6) 60 days (7) 75 days, and (8) 90 days after treatment, respesctively.

A 98 percent stand was obtained when winter barley was seeded 45 days after the 2,4-D had been applied to the soil. The percent stand from seedings made earlier ranged from 82 to 95, with the lowest obtained when seeded 15 days after treatment.

Oats, from the averages of five tests, produced a 97% stand when seeded 45 days after treatment, while 100 percent stands were obtained from the 60-day seedings. Earlier seedings produced stands ranging from 87 to 92 percent of normal, with the stands reduced most when seeded 15 and 30 days following 2,4-D applications. It is of interest to note that in some cases, although as high as 100 percent germination of oats was recorded from the 0 and 5 day seedings, some 15 days after emergence, the plants began to yellow and die resulting in reduced stands, vigor and yield.

Wheat appeared only slightly less tolerant to residual 2,4-D as compared with oats and barley and the results presented a very similar trend

On the other hand intermediate wheatgrass, as shown by one experiment, was most severely injured when seeded just before the spray application was made - a 49% stand recorded Subsequent seedings ranged upward and when seeded 30 days following 2,4 D treatment a 100% stand was obtained A reasonable explanation of this appears to lie in the fact that the first seeding of the shallow-seeded wheatgrass was made in dry soil and germination did not occur until a rain had been received and leaching of 2,4 D into the soil was started

Corn appeared to be relatively tolerant to residual 2 4-D in the soil The stand of corn averaged three percent above normal when plated just before application of 2,4-D. However the stand was reduced 10% of normal when planted 30 to 45 days after treatment At 60 days after spraying, a 99% stand was again produced. In some cases the vigor and yield of corn was increased by applying 2,4-D to the soil before planting Whether this was due to control of weeds or other factors is not definitely known. It was reported that annual weeds were controlled much better where the soil had been sprayed with 2 4-D as compared with untreated soil.

Mung beans were unaffected by residual 2,4-D in the soil. This crop plant evidently is immune to 2 4 D even when applied directly to the foliage

The stand of cowpeas, in one test, was reduced to 60% of normal when planted immediately before applying 2,4-D to the soil. However, plantings made 5 days later and all subsequent plantings resulted in 100 percent stands.

A report on soybeans indicated a complete failure of the beans when planted 0 to 5 days after 2,4-D treatment although when plated 30 days later the resulting stand was 100 percent.

Flax was rather severely injured by residual 2,4-D in all seedings up to 60 days following treatment at which time a 100 percent stand was recorded. When seeded immediately before treatment an average stand of 28 percent normal resulted. When seedings were made 5 to 45 days after treatment, the stands ranged from 53 to 83% of normal One report indicated in some instances an increase in the yields of flax during a season of low rainfall on a well drained sandy soil where 2 4-D was used.

From one test the stands of Midland milo were reduced 90% or more in the first two plantings and were reduced considerably in the plantings made 30 days after spraying However the yields of milo were reduced very little in plantings made 30 days or more after the spray applications.

Sweet Clover appeared to be one of the most sensitive and was affected longer by residual 2,4-D in the soil than any other crop plant When seeded just before spraying 2,4-D an average of five tests showed a 96% reduction in stand resulted. Even in seedings made 60 days after treatment, the average reduction in stand was still 46%.

The reactions of alfalfa to 2 4-D in the soil were very similar to sweet clover. When seeded immediately before spraying, the results were a complete failure. However, approximately 65% stands were obtained when seeded 30 and 45 days later.

Lespedeza was a complete failure in the first two seedings, but ranged upward until a 100 % stand was obtained when seeded 30 days after treatment.

Garden peas and garden beans showed more severe and longer detrimental effects of residual 2 4 D than the cereal crops but were more tolerant than the legume crops. Forty-five days after treatment plantings of peas produced an 87% stand while 60 days after spraying the stand of beans averaged 80% of normal. It was again reported that although germination of beans was good in the earlier seedlings many plants died later and others did show a below normal growth for the rest of the season leaves having a tendency to roll and turn yellow.

Transplanted tomatoes averaged slightly more tolerant to 2,4-D in the soil than beans or peas. Plantings made 45 days after spraying appeared to be normal. In the case of transplanted tomatoes some reports showed that the injury from residual 2,4-D did not appear until from one to two weeks after planting. At this time, the plants became stunted, the leaves rolled and turned yellow, and the resulting fruit was of very poor shape and quality. Examination of dead plants revealed brown and burned tissue

One report indicated that spinach was severdy injured by residual 2,4-D. Plantings made 45 days after spraying resulted in a 78% stand.

The vigor and yield data given in the reports submitted did not set definite trends. In many cases, the percent stand was reported good but subsequent vigor of the crop plants was low resulting in reduced yields. On the other hand, in some cases the percent stand was poor but the vigor high and relatively good yields were obtained. Although in a few cases yields were increased after 2,4-D was applied to the soil in most instances some reduction in crop yields resulted. This was often true even after the percent stand and vigor of the crop plants was recorded to be 100% normal indicating that 2,4 D may cause detrimental effects not visible to the naked eye.

Probably two of the most important factors contributing to the intensity and duration of detrimental effects on crop plants of 2,4-D in the soil are rainfall and soil type. In many instances the reduction in stand and growth of crops was much more in the second and third plantings than in the first.. This apparently was due to the fact that, having been seeded in moist soil, seedlings of many crop plants had emerged before rain was received to leach the 2,4-D into the soil There is every indication that many plant seedlings a few days old have considerable more resistance to residual 2 4-D than those which must germinate in a 2,4-D media. Therefore it appears that the intensity and duration of the effects of residual 2 4-D is not only dependent upon the susceptibility of thecrop plant itself but also upon the amount of soil moisture at time of planting and the time and amount of rainfall received following 2,4-D applications which apparently leaches the chemical into the soil where it is taken up by the germinating seed or seedling plant.

Reports also indicated that emergence of crop plants was often delayed as much as a week where the soil was treated with 2,4-D as compared with untreated checks.

There is also evidence that injury to crop plants is not as severe and not as long in duration resulting from residual 2,4 D in light, sandy soils as compared with heavy, clay soils.

Apparently 2000 parts per million of 2 4-D had slightly more detrimental effects on crops when applied to the soil than 1000 ppm. Residual effects of all different types of 2,4-D were quite similar However, the amine type of 2,4-D appeared to injure crop plants somewhat more severely and was of longer duration than either the sodium salts or the esters while the esters seemed to give slightly less injury than the sodium salts. This is an interesting contrast since it appears to reverse the order of results obtained when applying these different types directly to the plant foliage.

In a general resume, residual 2 4-D in the soil causes injury to nearly all crop plants, in many instances severe injury, but the duration of this injurious effect is relatively short as compared with the common contact herbicides. Most cereal and vegetable crops may be safely planted in soil treated with 2 4-D at rates and concentrations practical for weed control 8to 10 weeks after the application under most conditions However the legume crops, such as alfalfa and sweet clover, should not be planted until 10 to 12 weeks followingtreatment.

Mr. Worzella. Thank you Dr. McCall. Now let us hear from Mr. Dunham of Minnesota.

Mr. Dunham. Thank you very much. We had about the same results with alfalfa but we did not find soy beans sensitive as was reported in previous experiments. I think, now as I go along that it is the difference in the soil, that is, whether 2,4-D was entirely chemical or otherwise. I have no evidence -- probably the reason we have these differences is due to the bacteria of this soil and it is probably in the organisms.

Mr. Worzella. Thank you Mr. Dunham. Any more questions?

Mr. Ball from California. Any ill effects on rice?

Mr. Clair Brown, Louisiana. We spray rice seedlings and we can stunt rice very easily. Usually spraying rice when it is three weeks old not only gives you good control of the weed but we have gotten an increased yield varying from 2 to 12 barrels of rice per acre. There was no injury to the root system. Rice produces what we term water roots. Those roots are not injured and I think this is the reason why we have had our success with rice.

Mr. Ball. We have had good success. Our recommendations for this coming season is to use ten pounds of 10% and 10 pounds of 15% dust after flooding.

Mr. Otis from Washington. Did you give data on soil moisture or was that taken into consideration?

Dr. McCall. We knew that was very arbitrary but what we tried to do was set up the general rule to the right appropriation of all the results. Even under all conditions.

Mr. Worzella. Next subject will be taken up by Dr. Willard. Report of the Policy Committee on New Herbicides. Tentative report for your discussion as it is read.

## REPORT POLICY COMMITTEE ON HERBICIDES

By Dr. C. J. Willard

On the basis of the accumulate data from the two years of extensive experimentation, the Conference approves and adopts the following tentative statements and recommendations relative to the use of herbicides in 1947. It is understand that these recommendations are entirely tentative, that they apply to the year 1947 only and that they are subject to complete review and change at the next annual conference meeting in 1947 on the basis of experimental results and from experience accumulated subsequent to this action. The final recommendations in the use of herbicides in any of the member states will be prepared by the weed officials in those states for use under their own conditions. The following statements may serve as a guide to the various weed officials in making their recommendations.

1. Two years of research have proven 2,4-D preparations to be valuable herbicides - useful tools in the unending fight against weeds. They may be advantageously used: (For the reaction of specific weeds and crop plants, consult the lists at the end of this report.)

a. To control broadleaved weeds in lawns and turfed areas generally, (Caution is required on bentgrass and buffalo grass lawns.)

b. To control and perhaps ultimately eradicate a large variety of broadleaved weeds and many woody plants from ditch banks, rights-of-way, fence rows, stony areas, and many other areas which it is not possible or desirable to plow or cultivate.

c. For spot treatment of susceptible perennial weeds in pastures, or to control susceptible annual and perennial weeds in pastures where legumes are not an important component.

d. To reduce the vigor and begin the eradication of susceptible perennial weeds, either alone or in resistant growing crops.

e. To control many annual weeds, either alone or in resistant growing crops.

f. For the prevention of seed production of some annuals and perennials, either on land not in crops, or in resistant growing crops.

It should be definitely recognized that killing of all perennial weeds in an area at one application is the exception rather than the rule. Retreatments of most weeds and of most weedy areas are to be expected. It is an advantage of 2,4-D that these treatments can be applied at less cost and with less interruption of the productive use of the land than with any other chemical weed killer now in wide use.

2. Sodium chlorate and proprietary mixtures based on it are approved for the control of small areas of perennial weeds, especially those resistant to 2,4-D.

3. Borax is approved as an effective herbicide for the control of certain perennial weeds such as leafy spurge and dogbane.

4. Ammonium sulfamate is approved for the control of poison ivy, poison sumac and other woody weed plants, and for the killing of sprouting stumps.

5. The dinitro selective sprays are recommended for the control of annual weeds in flax, peas cereals and certain other crops.

6. Again in 1946, 2 4-D has proved to be generally effective against broad leaved lawn weeds. It is the most useful herbicide now known for this purpose.

7. Formulations of 2,4 D promise to be valuable adjuncts to cultivation and smother crop methods of control and eradication. The best ways of combining these

methods are yet to be worked out.

8. An outstanding advantage of 2,4-D in controlling many broadleaved weeds in grass pastures, fence rows, sod waterways, grassed ditch banks, terraces and terrace outlets, and other situations where erosion is a factor, is that the broadleaved weeds may be controlled and perhaps ultimately eradicated without injury to the erosion preventing grasses.

9. The 0.1% solution 2,4-D acid or equivalent may be considered the standard concentration. Spray of this concentration, applied in amounts sufficient to wet all leaves on low-growing or turf areas, will require about 1 U.S. gallon per square rod, or about $1\frac{1}{4}$ pounds of 2,4-D acid or equivalent per acre. Heavier growths may require up to 2 gallons of spray per square rod, or about $2\frac{1}{2}$ pounds of 2,4-D acid or equivalent per acre. Under many conditions, the use of about half the standard amount is desirable for the control of susceptible annual weeds in resistant growing crops. More resistant plants may require up to double the standard amount, or $2\frac{1}{2}$ to 5 pounds of 2,4-D acid or equivalent, per acre.

These same amounts of 2,4-D per acre may be satisfactorily applied by any means giving adequate and uniform coverage, such as dusts or concentrated sprays. The conditions indicated under (10), especially the stage of growth, are much more important in determining the results of a given 2,4-D treatment than small or even considerable variations in concentration and rate of application.

These suggestions are not intended to supplant local directions, or the directions of manufacturers.

10. Some factors which affect the results of 2,4-D treatments are:

a. The kind of plant. The remarkable selectivity of 2,4-D is at once its greatest source of value or its greatest weakness, depending on the results desired.

b. Stage of growth. Plants in active growth, or seedlings, have generally been much more susceptible than the same plant in dormant or mature stages.

c. Soil moisture and fertility. Conditions which promote active plant growth make weeds more susceptible to 2,4-D.

d. Temperature. Low temperatures (40° to 60° F.) slow up the speed of action more than they reduce the final effect of 2,4-D. The early warnings against treating at temperatures below 60° F. were much too drastic. Extremely high temperatures may contribute to poor kills.

11. Although there are large and obvious differences in the effectiveness of different 2,4-D formulations under certain conditions and for certain plants, we feel that this is too soon to assess them definitely, because of the enormous number of modifying factors involved. In general, the formulations

containing 2,4-D esters have been more active and effective under difficult conditions and on resistant plants than the other formulations.

12. Treatments of weeds in small grains with 2,4-D may be made before jointing or after the grain has reached the milk stage, with less damage than at other stages of development. Weeds in corn can only be treated safely after the milk stage.

13. When 2,4-D is applied to the soil in standard amounts in humid areas, leaching and decomposition remove it in a comparatively short time. Only rarely will plants be injured by planting two months after applying 2,4-D to the soil, if normal rainfall and spring and summer temperatures have intervened, and the less susceptible plants may be sown in a month. Under dry soil conditions, the toxicity may remain much longer - perhaps a year or more.

14. Suitable equipment and methods of application are a limiting factor in many uses of 2,4-D, and intensive research on these problems is needed. Dust applications are feasible and desirable under some conditions.

15. Tests have demonstrated that no injury to livestock in treated pastures is to be anticipated from standard treatments with present formulations of 2,4-D.

16. We recommend that labels of 2,4-D weed killers give the following information:

a. 1 For solids, the net weight (avoir) in the package.
2 For liquids, the contents of the package in liquid measure, and the net weight (avoir.) in the package.

b. The chemical compound(s) of 2,4-D which constitute (s) the active ingredient.

c. The equivalent percentage by weight of 2,4-D acid in the formulation as sold.

d. Or, in lieu of (c) and, for liquids, the avoirdupois weight provision of (a), the equivalent weight (avoir.) of 2,4-D acid in the package, or per unit in the package.

To save many calculations, the following table of 2,4-D equivalents is given:

| Substance | Molecular Weights | Percent 2,4-D Acid | Units required to Contain 100 units of 2,4-D acid |
|---|---|---|---|
| 2,4-D acid | 220 | 100 | 100 |
| 2,4-D ammonium salt | 237 | 93 | 108 |
| 2,4-D sodium salt (anhydrous) | 242 | 91 | 110 |
| 2,4-D sodium salt Monohydrate | 260 | 85 | 119 |
| 2,4-D diethanolamine salt | 305 | 72 | 139 |
| 2,4-D triethanolamine salt | 339 | 65 | 154 |
| 2,4-D methyl ester | 234 | 94 | 106 |
| 2,4-D ethyl ester | 248 | 89 | 112 |

| | | | |
|---|---|---|---|
| 2,4-D propyl esters (two, same weight) | 262 | 84 | 119 |
| 2,4-D butyl esters (four, same weight) | 276 | 80 | 125 |
| 2,4-D amyl esters (about 15, all with same weight) | 290 | 76 | 132 |

17. It is impossible for the personnel now working with weed control problems to answer the questions put to them for sheer lack of time. With a multitude of new chemical and other weed control methods on the horizon, every member of this conference should emphasize at all times the need for greatly enlarged research appropriations for weed control studies. No action program can be better than the research on which it is based.

18. Lists of weeds and crops "susceptible", "intermediate", and "resistant" to 2,4-D are given below. These terms refer, so far as possible, to their reaction when treated in an actively growing stage. Many "susceptible" weeds are intermediate, or resistant when mature. Despite another year's data, these lists are not completely reliable. When in doubt, the attempt has been to be conservative, but there undoubtedly are weeds which are wrongly placed.

A. Annual and winter annual weeds.

Group 1. SUSCEPTIBLE. Plants readily killed by 2,4-D, at least at early stages. See above.

Beggar-ticks
Lappula echinata
Black medic or yellow trefoil
Medicago lupulina
Bitter wintercress
Barbarea barbarea
Blue bur
Lappula sp.
Butterprint, Indian mallow, or velvetleaf
Abutilon theophrasti
Carpetweed
Mollugo verticillata
Cocklebur
Xanthium sp.
False flax
Camelina sp.
Fanweed, Frenchweed, Stinkweed
Thlaspi arvensis
Flower-of-an-hour
Hibiscus trionum
Galinsoga
Galinsoga parviflora
Hemp
Cannabis sativa
Hemp-nettle
Galeopsis tetrahit
Morning glory (not perennials-See bindweeds, Group B1 and B2)
Ipomea sp. (annuals)
Mustard, ball
Neslia paniculata
Mustard, hare's ear
Conringia orientalis
Mustard, Indian
Brassica juncea
Mustard, tumbling
Sisymbrium altissimum
Mustard, wild or charlock
Brassica arvensis
Mustard, wormseed or treacle
Erysimum choiranthoides
Mustard, tansy
Sophia sp.
Orache
Atriplex hastata
Peppergrasses
Lepidium virginicum and apetalum
Pigweeds (rough, prostrate, tumbling, etc.)
Amaranthus sp.
Pineapple weed, wild marigold
Matricaria matricarioides
Prostrate vervain

Henbit or dead-nettle
Lamium amplexicaule
Indian mallow See Butterprint
Jewelweed
Impatiens pallida
Jimsonweed
Datura stramonium
Kochia
Kochia scoparia
Marsh elder
Iva xanthifolia
Rough cinquefoil
Potentilla monspeliensis
Saltbushes
Atriplex sp.
Sow thistle, annual
Sonchus cleraceus
Sunflower
Helianthus annuus
Verbena bracteata
Puncture vine
Tribulus terrestris
Radish, wild
Raphanus sativus
Ragweed, common
Ambrosia trifida
Ragweed, giant
Ambrosia trifida
Rape, annual
Brassica napus
Vetches
Vicia sp.
Wild cucumber
Sicyos angulatus
Yellow star thistle
Centaurea solstitialis

Group 2. INTERMEDIATE. Plants less readily killed by 2,4-D than those in Group 1, but control by 2,4-D feasible under favorable conditions or with high concentrations. Plants often recover after treatment.

Bedstraw
Galium sp.
Buckwheat, wild
Polygonum convolvulus
Chickweed, common
Alsine media
Coreopsis
Coreopsis tinctoria
Dog-fennel. See Mayweed
Dodders
Cuscuta sp.
Fleabane, daisy
Erigeron annuus
Fleabane, Philadelphia
Erigeron philadelphicus
Goosefoot, oak leaved and others
Chenopodium sp.
Knotweed, doorweed
Polygonum aviculare and P erectum
Lamb"s quarters
Chenopodium album
Lettuce, prickly
Lactuca scariola
Lettuce, wild
Lactuca sp.
Mallow roundleaved
Malva rotundifolia
Marestail, Canada fleabane
Leptilon canadense
Mayweed or dog-fennel
Anthemis cotula
Mat spurge
Euphorbia glyptosperma
Purslane
Portulaca oleracea
Russian thistle
Salsola pestifer
Shepherds purse
Bursa bursa-pastoris
Smartweeds
Persicaria sp.
Speedwells
Veronica sp.

Group 3 RESISTANT. Nearly uninjured by 2,4-D. Control by 2,4-D probably not possible.

Annual bluegrass
Poa annua
Barnyard grass
Echinochloa crus-galli
Black nightshade
Solanum nigrum
Buffalo bur
Solanum rostratum
Catchflys
Silene sp.
Chess or cheat
Bromus secalinus
Corn cockle
Agrostemma githago
Cow cockle
Saponaria vaccaria
Crabgrass
Syntherisma sp.
Downy brome
Bromus tectorum
Foxtails, green and yellow
Chaetochloa sp.
Goose grass
Eleusine indica
Grasses (All weedy annual species in addition to those listed)
Family Graminaceae
Sandburs
Cenchrus sp.
Squirrel-tail grass
Hordeum jubatum
Wood sorrel
Oxalis sp.

B Perennial and biennial weeds.

Group 1. SUSCEPTIBLE. Tops readily killed by 2,4-D at some stages, roots frequently killed by one application.

Artichoke, Jerusalem
Helianthus tuberosus
Austrian field cress
Roripa austrica
Bindweed, hedge
Convolvulus sepium
Bindweed, field, east of Mississippi R.
Convolvulus arvensis
Buckhorn
Plantago lanceolata
Bull thistle
Cirsium lanceolatum
Burdock
Arctium minus
Catnip
Nepeta cataria
Chicory
Cichorium intybus
Cinquefoils, fivefingers
Potentilla sp.
Coneflowers
Ratibida sp.
Creeping Charley. See ground ivy
Creeping Jenny. See bindweed, field
Dandelion
Taraxacum officinale
Hoary alyssum
Berteroa incana
Horsetail
Equisetum arvense
Lawn pennywort
Hydrocotyle umbellata
Licorice, wild
Glycorrhiza lepidota
Loco weed
Oxytropsis lamberti
Moonseed
Menispermum canadense
Mouse-ear chickweed
Cerastium vulgatum
Nettle, stinging
Urtica dioica
Plantains
Plantago sp.
Poppy mallow
Callirrhoe involucrata
Roadside thistle
Cirsium discolor
Rosin weed
Silphium sp.
Sagebrush or wormwood
Artemisia sp.

Dragonhead
Dracocephalum parviflorum
Evening primroses
Oenothera sp.
False ragweed. See Marsh elder
False sunflower
Heliopsis scabra
Figwort
Scrophularia leporella
Fivefinger. See cinquefoils
Four-o'clock
Allionia nyctagenia
Ground ivy
Glecoma hederacea
Gumweed
Grindelia squarrosa
Heal-all
Prunella vulgaris
Hedge bindweed. See bindweed
Hedge nettle
Stachys palustris
Scouring rush. See horsetail
Skeleton weed
Lygodesmia juncea
Slender rush
Juncus tenuis
Sunflowers (perennial)
Helianthus sp.
Sweetclovers
Melilotus sp.
Water hemlock
Cicuta maculata
Western ragweed
Ambrosia psilostachya
Wild parsnip
Pastinaca sativa
Wild sweet potato, man-of-the earth
Ipomea pandurata
Vervains
Verbena sp.
Vetch, bird or tufted
Vicia cracca
Vetch, crown
Coronilla varia

Group 2. INTERMEDIATE. Tops partly or completely killed by 2,4-D at early or rapid growth stages: roots seldom killed except by repeated treatments: control by 2,4-D probably possible under favorable conditions and/or with repeated treatments. Eradication by 2,4-D not certain. For most weeds, no experiments have continued long enough to determine the possibility of eradication.

Bindweed, field, west of Mississippi river
Convolvulus arvensis
Blueweed
Helianthus ciliaris
Bouncing Bet
Saponaria officinalis
Bur ragweed
Franseria tomentosa
Buttercups
Ranunculus sp.
Canada thistle
Cirsium arvense
Carrot, wild
Daucus carota
Cattail
Typha sp.
Docks
Rumex sp.
Dogbane
Apocynum cannabinum
Gourd, wild
Cucurbita foetidissima
Houndstongue
Cynoglossum officinale
Lettuce, blue perennial
Lactuca pulchella
Pokeweed
Phytolacea decandra
Poverty weed
Iva axillaris
Silverleaf poverty weed
Franseria discolor
Sorrel, red or sheep
Rumex acetocella
Teasel
Dipsacus sylvestris
Wild garlic
Allium vineale
Wild onion
Allium canadense

Goatsbeard
Tragopogon
Goldenrods
Solidago sp.
Yarrow
Achillea millifolium

Group 3. RESISTANT. Tops and roots slightly or not atall injured by 2,4-D: control by 2,4-D probably not feasible.

Alkali mallow
Sida hederacea
Asters (many perennial weedy species)
Aster sp.
Bermuda grass
Cynodon dactylon
Bittersweet, climbing nightshade
Solanum dulcamara
Bracken
Pteris aquilina
Cactus, prickly pear
Opuntia sp.
Climbing milkweed
Gonolobus laevis
Ferns
Asplenium sp. and Aspidium sp.
Mullein, common
Verbascum thapsus
Night-blooming catchfly
Silene noctiflora
Nimblewill
Muhlenbergia schreberi
Ox-eye daisy
Chrysanthemum leucanthemum
Quackgrass
Agropyron repens
Russian knapweed
Centaurea repens
Spurge, cypress
Euphorbia cyparissias
Spurge, emargianted, snow-on-the mountain
Euphorbia marginata
Spurge, leafy
Euphorbia esula
Foxglove beardtongue
Penstemon digitalis
Goutweed
Aegopodium podagraria
Grasses (All perennial weedy species in addition to those listed)
Family Graminaeae
Ground cherry
Physalis sp.
Horse nettle
Solanum carolinense
Hoary vervain
Verbena stricta
Johnson grass
Sorghum halepense
Milkweeds
Asclepias sp.
Strawberry, wild
Fragaria americana
Swamp or perennial smartweed, tanweed
Persicaria coccinea
Tansy ragwort
Senecio jacobaea
Tick-trefoils
Meibomia sp.
Toadflax
Linaria vulgare
Violets
Viola sp.
White cockle
Lychnis alba
Wood sorrel
Oxalis sp.

C. Woody plants. (Data on this group particularly variable and uncertain.)

G Group 1. SUSCEPTIBLE. Leaves and current year's growth readily killed; entire plant often readily eradicated by repeated treatments Just after full leaf is most effective stage to treat woody plants.

Most broadleaved ornamental shrubs. Many of these recover after defoliation.

Alder
Alnus sp
Aspen
Populus sp.
Birch, black
Betula lenta
Boxelder
Acer negundo
Cherry wild
Prunus sp
Cottonwood
Populus sp.
Elderberry
Sambucus canadensis
Grape, wild and cultivated
Vitis sp
Hazel
Corylus sp.
Honeysuckle
Lonicera japonica
Lead plant
Amorpha canesens
Plum wild
Prunus sp.
Sumac poison
Rhus vernix
Sumac smooth
Rhus glabra
Sumac staghorn
Rhus typhina
Tamarisk
Tamarix sp.
Virginia creeper
Ampelopsis quinquifolia
Walnut, black
Juglans nigra

Group 2. INTERMEDIATE Leaves and current year's growth killed under favorable conditions, or with high concentrations, especially of esters: eventual kill probable, but requiring several to many treatments

Black locust
Robinia pseudo-acacia
Buckbrush, coralberry, Indian currant
Symphoricarpos orbiculatus
Elm
Ulmus sp.
Mulberry
Morus sp.
Poison ivy
Toxicodendron radicans
Tree of Heaven
Ailanthus glandulosa
Willows (species highly variable)
Salix sp

Group 3. RESISTANT Neither leaves nor stems seriously injured by 2,4 D.

All needle-leaved evergreens Pines spruces, arbor vitae, hemlocks yews, etc

Ash
Fraxinus sp.
Blackberry
Rubus sp
Dogwood
Cornus sp.
Meadowsweet
Spirea latifolia
Osage orange, "hedge"
Toxylon pomiferum
Raspberries, black and red
Rubus sp
Red cedar
Juniperus virginiana
Rose wild. Considerable variation between species and varieties, but data insufficient to specify.
Rosa sp

D. Crop and ornamental plants.

Group 1. SUSCEPTIBLE Too readily injured for selective spraying of weeds in them and readily injured by spray drift.

Practically all garden flowers and vegetables not listed in groups 2 and 3 - too numerous to mention.

Nearly all cultivated legumes tested: alfalfa, red clover, white clover, alsike clover sweetclovers field peas soybeans, cowpeas vetches, and others

Cotton

Flax

Hemp

Sorghums

Sugar beets
Sudan grass

Group 2. INTERMEDIATE. Not so readily injured as group 1. Selective spraying with suitable concentrations and formulations of 2 4-D possible in many of these plants with caution as to stage of growth

Asparagus
Barley (See Sec. 12)
Bent grass (Agrostis sp including redtop)
Buffalo grass
Corn (See Sec 12)
Oats (See Sec 12)
Potatoes
Rye (See Sec. 12)
Strawberry
Wheat (See Sec. 12)

Group 3 RESISTANT. Selective spraying with 2,4 D of weeds in these plants is generally possible

Evergreens, needle-leaved. (Pines spruces red cedar and other junipers, arbor vitae, hemlock, yews etc Some injury to new growth has been noted from spraying while in rapid growth.)

Most hay and pasture grasses Bromegrass, timothy common ryegrass, orchard grass, Kentucky bluegrass. Canada bluegrass, and Bermuda grass are among those definitely tested.

Myrtle, periwinkle
Vinca minor

The indefinite and inconclusive nature of these classifications based on limited data is shown by the results of such detailed studies as have been made. Corn, e.g., which is generally resistant, has been practically killed by some formulations of 2,4-D at some stages. Field bindweed in Kansas and Nebraska reacts differently from field bindweed in Indiana and Ohio - a difference clearly due to differences in climate and the interactions of bindweed growth with them. Where genetically distinct crop varieties have been available for test, as with apples, strawberries, etc., definite and important differences in sus-

ceptibility have appeared within the species. Such differences almost certainly exist in many if not most other species. Consequently, many of the classifications above are based on insufficient samples and cannot be expected to tell the whole story. Several plants above, e.g., were classified by different members of the Committee in all three groups.

As more formulations and concentrations of 2,4-D are used on more plants at more stages, the number of weeds and plants which can be controlled under some system of treatment with 2,4-D will tend to increase, but definite directions for each plant will be required.

Mr. Worzella. No further questions, so we shall adjourn until tomorrow.

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BANQUET
Thursday Evening Program
December 12, 1946

Mr. Yost. I have no part in this program except to introduce Dean Kildee of Iowa State College who is going to act as Toastmaster. Dean Kildee.

Dean Kildee. Governor Blue, Secretary Linn, Ladies and Gentlemen. We have for our opening address this evening the Honorable Robert D. Blue, Governor of Iowa, Governor Blue.

Governor Robert D. Blue's Address

I am happy to be here to meet with you of the North Central Weed Control Conference. I, therefore, welcome you to our Iowa.

I do not know whether there is anything good about weeds and I do not know whether there are many states that have weeds like Iowa. I have become rather acquainted with them from one of my earliest experiences when I was a small boy. To those of you who are not familiar with Iowa weeds, may I say to those that we grow the thriftiest, the most stubborn weeds to be found in the world. Because we have good soil, we usually grow mighty thrifty weeds. Seriously, we do have a problem of a more increasing importance than any of us realize.

Let us think of a weed as a robber and as such something to be treated as you would treat any thief. Many a farmer that will go out in the middle of the night with his shot gun to protect a few dozen chickens from being stolen, will permit his farm to be robbed of many bushels of grain throughout the seasons because of his lack of attention or perhaps lack of knowledge of the thieveries which are going on, on that particular place.

There are other men, who perhaps have not realized that with the coming mechanized farming, we have an entirely new weed problem, different from that which confronted us a number of years ago. Farmers have realized in the last

few years with the coming of the combine, we not only have a new labor saving machine but in many instances these combines are proving rather effective sowing machines so far as weeding weeds were concerned.

I am very glad to be here, and glad to know there is a group of men who are studying this problem and who are tackling it with scientific and practical ways. Most often many of the economic problem and the social problems which confront us are left idle until they have reached the point of crisis, and I think you men have gathered here to solve a problem of vast importance to Agriculture here in America, and by coming together each year much good will come not only to Agriculture but to society as a whole, and I can assure you here in Iowa, Legislature will help you with these weed problems.

I have worked with the legislature now for several sessions. Never has there been a session without a weed control act. Weed laws have been modified and improved to meet the problems we are confronted with here in this state.

It has been a pleasure to meet with you, may your work go on as successful as it has been. You have added much to Agriculture. Thank you.

## DEVELOPMENT OF NEW HERBICIDES BY THE CHEMICAL CORPS

Camp Detrick, Maryland, U. S. A.
Dr. Charles E. Minarik

Previous to the recent war, the chemical substances most widely used for weed control were sulfuric acid, chlorates, borax, arsenic and other inorganic plant poisons. These substances, although effective, have many undesirable features and consequently the search for new herbicides was initiated. Attention was drawn to certain compounds which have pronounced effects on plants when applied in minute quantities. These compounds are the so-called plant growth-regulators, or hormones, and include such compounds as naphtalene acetic acid, indole acetic acid, and indolebutyric acid, as well as the relatively newer naphthoxy, and phenoxy compounds.

It was conceived that these highly active growth-regulators might be useful as herbicides since concentrations slightly in excess of those used for rooting cuttings, producing parthenocarpy, etc., produce deleterious effects on plants. The originator of the idea that plant growth-regulators might be herbicides is a controversial point. It is not inconceivable that this thought occurred to a number of individuals independently. However, during the war year personnel connected with this program were not permitted to make any reference to the use of growth-regulators as herbicides, consequently their names do not appear in the literature of that period in connection with this rapidly expanding field.

The first plant growth-regulators which we tested as herbicides were derivatives of phenoxyacetic acid, some of which were first tested for growth-

regulatory activity by Zimmerman and Hitchcock at Boyce Thompson Institute. The search for herbicides did not stop with the phenoxy compounds but included scores of other types of compounds such as benzoic, naphthoic, phthalic, sulfamic, carbamic and cinnamic acids and their derivatives as well as a host of other organic chemicals. Other homocyclic and heterocyclic rings replaced the benzene ring of the phenoxy grouping. Various substituents such as chlorine, bromine, nitro, amino and alkyl radicals were introduced into the different rings and scores of different side chains were also introduced into the molecules in an effort to obtain even more potent herbicides. If a particular compound displayed unusual activity many derivatives of it were prepared. In addition to these compounds, still other groups were tested if the literature survey indicated that they possessed some activity in stimulating, inhibiting or in some other manner affecting normal biological processes.

The bulk of these compounds were prepared by four chemists at Camp Detrick. The remainder were prepared under the supervision of Dr. Melvin S. Newman at Ohio State University. The entire program, except in its very earliest stages, was directed by Dr. A. G. Norman who was then on leave of absence from Iowa State College.

At the inception of this program, it was soon apparent that a rapid and accurate method for the evaluation of herbicidal activity had to be devised. Methods in use by other investigators for measuring growth-regulatory activity could not be readily adapted to our needs, so several screening methods were developed.

One test which yielded reproducible results, was rapid, could be carried out by unskilled technicians and had a high degree of correlation with results of greenhouse and field trials was the corn germination test. This consists of placing 25 corn seeds on filter paper in a 6 inch petri dish, adding 20 ml. of a 10 ppm. solution of the compound being tested and incubating at 28°C. for four days. At the end of this time, the length of the primary root is measured and the degree of inhibition of elongation expressed as a percent of the inhibition produced by the standard - 2,4-D.

All compounds were tested by this method except those whose solubility was less than 50 ppm. Credit for developing this method goes to Naval Lieutenant Carl P. Swanson, who is now headof Botany at Johns Hopkins University.

Another method for determining herbicidal activity was developed by Dr. John W. Mitchell, Bureau of Plant Industry, U. S. Dept. of Agriculture, who was connected with the project on a contract basis. This method is referred to as the kidney bean water droplet test and was useful not only for determining degree of activity but also permitted observasions for formative and telemorphic effects. Young kidney bean plants were treated by placing a single drop containing 4 gamma of an aqueous solution of the compound to be tested upon one of the primary leaves. Four gamma is 4 millionths of a gram or point six zeros-twelve ounces. A hypodermic syringe capable of delivering 0.02 ml. was used for this purpose. After 10 days, the fresh weight of the new growth above the second node

was determined. The inhibition caused by the test substance was compared with that produced by the standard, 2,4-D.

Results of this test compare very favorably with those of the corn germination test. However, since the test solution is more concentrated than that used in the previous test, many compounds could not be subjected to this test even though consolvents were employed to aid solution.

A third test was devised for evaluating compounds with low aqueous solubility but sufficient solubility in No. 2 Diesel oil to produce a 500 ppm. solution. If the compounds were not directly soluble in oil, they were first dissolved in tributylphosphate and then introduced into the oil. The test was similar to the water droplet test except that the plants were slightly older, and a smaller volume of a more concentrated solution was used. The method is admirably suited for the selection of compounds with high activity in oil solutions but the test is slightly less reliable than the other two screening tests because of mechanical difficulties in performing it. A drop of oil placed on the leaf blade is inclined to run down the petiole to the growing point. This frequently kills the growing point especially if the solution contains tributylphosphate - which incidentally is a good contact herbicide in its own right. If the droplet is placed farther back on the leaf blade, the plant response is diminished. It was considered advisable to have a screening test in which the test substance was dissolved in oil because of the superiority of oil solutions over water solutions and because many phenoxy compounds are much more soluble in oil than in water. The rapid penetration of the oil solutions into the leaf tiss is an important factor contributing to the greater effectiveness of oil solutions

A number of other screening tests were developed but I shall not describe them here, suffice it is to say that they were all based on inhibition of fresh weight production or inhibition of elongation, and the activity of all compounds was compared with that of 2,4-D which was arbitarily assigned a value of 100.

After evaluation by the three primary screening methods, those compounds showing most promise were tested in greenhouse experiments and finally in field trials.

Concurrently with the synthesis and screening programs, a group of investigators was busily engaged in establishing the most practical methods of applying herbicides. Two methods immediately suggested themselves - first, spray of liquid solutions, second, dusting the solid compound.

The low aqueous solubility of 2,4-D made it necessary to investigate suitable co-solvents or solubility aids to permit the preparation of more concentrated solutions. The Na and $NH_4$ salts were the first answer. These salts are soluble to the extent of about 3%. The ethanol amines and polyethylene glycoles permit even greater solubility, somewhere in the neighborhood of 30%. The solubility of 2,4-D. and related compounds in oil, as has already been mentioned, can be greatly enhanced by first dissolving the compound in tributylphosphate (TBP). At ordinary temperatures TBP will dissolve up to about 36% by weight of 2,4-D.

Solutions in this range can then be diluted to any desired concentration with kerosene or low-grade fuel oil. Those of you who may be considering using solutions containing TBP for the control of aquatic plants must be careful that the resultant concentration of TBP in the water does not exceed 20 ppm. since this concentration is toxic to some species of fish. Oil solutions containing TBP are not recommended for ridding pastures of weeds because of the burning effect of TBP on the grasses and other desirable types of vegetation. Plants which are resistant to the herbicide outgrow the contact injury of the TBP, to be sure, but it does give them a temporary set-back. Solutions containing TBP are recommended principally where all vegetation is to be destroyed or where temporary set-back of desirable vegetation is of little importance. Certain esters of 2,4-D are liquids which are miscible with oil in all proportions and consequently need no cosolvents. These are now being used in some commercial preparations and may find even wider use than the straight 2,4-D acid.

Investigations of rates of application for 2,4-D indicate that 100 mg. per sq. yd. or one pound per acre is sufficient to control most broadleaf plants, especially in the early stages of development. As a plant gets older and less succulent its susceptability to 2,4-D decreases. This suggests that the best time to eradicate weeds is when they are seedlings. Annual weeds can also be controlled if sprayed when in the flowering stage. This tends to reduce the number of seeds which will be present in the soil for the next season's growth. Where it is to practice now to use 100 gallons of a very dilute solution per acre the same results may be obtained by using only 2 gallons of a more concentrated solution for the same area. It is not necessary to saturate each plant as is currently done, for a few drops of the concentrated solution produce just as effective results. The most important consideration in this regard is that the volume of spray solution is not a limiting factor as long as uniform coverage is obtained and the weight of herbicide per unit area is adequate to give the desired weed control. The translocatability of these growth-regulators within the plant is the factor responsible for this high activity. The herbicide is translocated to the growing points of plants where it does its greatest damage.

Reduction in the volume of spray material means modification of present spray equipment with the use of lower pressures to prevent undue loss by vaporization. Where large areas are to be treated, airplane spraying or dusting could be employed to great advantage. The same planes which fertilize from the air or dust crops with fungicides or insecticides could be used for this purpose with perhaps only slight modifications. This is actually being done now in the rice areas of Louisiana, Texas and California. Over 30,000 lbs. of 2,4-D were used to control weeds in rice fields in Texas alone last year and most of this was distributed from the air. The airplane is also being used in control of water hyacinth in drainage and irrigation ditches in Southeast Texas - at least on an experimental scale. Dr. Tullis of the U. S. Department of Agriculture obtained excellent control of water hyacinth by airplane dusting with 2,4-D.

There is one bad feature connected with the use of planes and that is drifting of 2,4-D. In several instances where a field was dusted, the herbicide drifted to an adjacent cotton field where it did considerable damage. This means

that 2,4-D should be applied on calm days when there is a minimum of air movement.

The influence of rainfall on aqueous and oil sprays of 2,4-D showed that a heavy rain coming within 24 hours after spraying with aqueous solutions reduced the effectiveness of the weed killer. Rain coming 15 minutes after spraying with an oil spray on the other hand did not reduce effectiveness. Thus an oil carrier for herbicides may be advantageous in regions of frequent and heavy rainfall.

In respect to disseminating herbicides in the dry form much work was done on diluents since the undiluted compound cannot be distributed uniformly over an area of any size. All diluents tested were adequate with no one superior to any of the others. However, one disadvantage of applying the substance in the solid form is that larger quantities of the substance are required to produce the same degree of inhibition as is obtained with a liquid spray. Another disadvantage is the time lapse between application and plant response which is dependent upon moisture.

Pellets of different sizes were also prepared using various diluents and binders. These were most effective in the smallest sizes since they permitted the most uniform distribution. A good use of pellets can be made in ponds and slow moving bodies of water to eliminate undesirable submerged vegetation. The pellet, being heavier than water, will sink, gradually disintegrate and the herbicide will diffuse over the bottom of the pond. Such treatments are not harmful to fish except where too rapid decomposition of the vegetation may deoxygenate the water. Fish can tolerate 50 ppm. of 2,4-D without harmful effects, however, fish taken from ponds treated with 2,4-D have a slight 2,4-D flavor. 2,4-D itself is not poisonous to men or animals.

It is well known that at the rates commonly employed for the eradication of weeds from lawns and pastures, 2,4-D is non-injurious to grasses. However, at higher concentrations it is toxic to members of the grass family. In nutrient solution studies concentrations as low as 1 ppm. in the nutrient solution had pronounced effects on such cereals as corn, wheat, rice, and oats, but when solutions of 2,4-D are sprayed upon the leaves of these same cereals they do not appear to be affected in the slightest degree. This suggests that the compound either does not enter the plant through the leaves or that it may enter but is not translocated within the plant. Another explanation may be that on being absorbed by the plant roots it becomes localized at the crown region causing inhibition of root elongation with the result that eventually the plant suffers from lack of sufficient water and nutrients.

Members of the grass family have proved to be more difficult to control than broadleaf plants. This condition has stimulated a search for a compound which is effective against gramineae but which will not harm broadleaf plants. Such a compound is isopropyl-N-phenylcarbamate. Studies made with this compound show that it inhibits the growth of corn, wheat, barley, oats and rice and has no effect on soybeans, kidney beans, cowpeas, sunflowers, turnips, radishes or

sugar beets. Buckwheat, tomatoes and potatoes are the only broadleaf species tested which were affected by the carbamate; tomatoes were stimulated and the potatoes temporarily stunted. Sublethal doses of the isopropyl compound on cereals cause stunting, increase tillering, produce a darker green coloration and delay heading.

Although this compound is active on the cereals mentioned, its effectiveness on other grasses has not been tested. Many inquiries have been received from weed control workers requesting a source for this material. There is one company that I know of which produces it. If anyone is interested, I shall be happy to give them the name after the meeting.

Another compound which displayed specificity for a particular species is 2,4-5 trichlorophenoxyacetic acid. This herbicide is the only one tested which damaged potatoes to any appreciable extent. Not only was the aerial portion of the plant inhibited but tubr yields were reduced approximately 90%. Tubers from treated plants were small and had a warty, scab-like appearance. Potato vines and tubers were not affected by 2,4-D and it is suggested that this substance may find use as a selective herbicide in potato fields.

2,4-D did produce one unusual effect and that was the stimulation of formation of seed balls. No attempt was made to test the seed for viability since they were harvested before maturity.

Another phase of these investigatbns wasconcerned with the persistence of weed killers in the soil. This was tested by applying very heavy rates to soil in field plots and making plantings of sensitive species every 10 days.

Results which show that of the herbicides tested 2,4,5-trichlorophenoxyacetic acid persisted the longest and was followed by 2-methyl, 4-chlorophenoxyacetic acid, 2,4-D and isopropyl -N-phenylcarbamate in that order. More recent investigations indicate that derivatives of 2,4-5 trichlorophenoxyacetic acid also are more persistant than 2,4-D There are several factors which may influence the differential persistence and one is solubility. The more soluble compounds may be leached out of the soil sonner than the less soluble. Another factor may be decomposition of the compounds by soil microorganisms. There is some information available from work conducted by Dr. Arthur S. Newman at Camp Detrick that soil microorganisms may be the most important factor influencing persistence in the soil. Many of you may remember Dr. Newman when he was connected with Iowa State College just prior to the war.

In conclusion, I wish to state that many other aspects of plant growth regulation were studied and much information has been developed which can be of inestimable value in agriculture. All scientific knowledge has been and will continue to be published in technical journals. The thousand odd compounds which we tested for herbicidal activity have not been exploited to the utmost and among them may be some which are specific for a particular plant which we did not test. The responses we were looking for were inhibition, but stimulation and formative effects were frequently observed. Plant growth-regulators are finding

use for setting tomato fruits in greenhouses, for preventing preharvest drop of apples, for ripening starchy fruits, for rooting cuttings, for prolonging dormancy of stored potatoes and buds of fruit trees until danger of frost is passed in the spring. No doubt many other uses can be found and new compounds may replace those now most widely used for the purposes just enumerated. The use of plant growth-regulators for herbicidal purposes has many ramifications as you well know and as we develop information in this field, it will be disseminated where it can do the most good. In this respect, we do not wish to be considered competitors with the weed control organizations of the various state experiment stations, universities or departments of agriculture, but rather we want to exchange information freely with such organizations in accomplishing our common objective of eradication of undesirable vegetation.

## THE USE OF HERBICIDES IN THE TVA MALARIA CONTROL PROJECT

DR. A. D. HESS,

Chief, Biology Staff, Malaria Control Division, Health & Safety Dept., Tennessee Valley Authority, Wilson Dam, Alabama.

The production of Anopheles quadrimaculatus, the only important vector of malaria in the Southeastern States, is invariably associated with the presence of plants and flotage in the waters of the breeding area. In many situations, the most efficient measures for preventing the propagation of this mosquito are those which eliminate the plants which create favorable conditions for its production. For this reason, plant control constitutes one of the major elements in the Tennessee Valley Authority's program of malaria control. This program involves nine major river and sixteen storage reservoirs with a total shoreline of almost 10,000 miles and an area of about 600,000 acres. The major plant control operations are directed at the terrestrial and wetland species which invade the marginal zones of fluctuation, but the control of certain deep water aquatics is also a highly essential element.

In general, phytocides have had a minor role in the Authority's plant control operations, although in some instances they have been used with considerable success as, for example, in the control of alligator weed on Lake Wilson through the application of an oil herbicide. The recent discovery of the remarkable phytocidal properties of 2,4-D and related growth-regulating substances caused the authority to re-appraise the status of phytocides in its plant control operations. During the summer of 1945, small-scale field tests were carried out with 2,4-D and some of its derivatives to find out if these materials might be used to control some of the problem species in the Tennessee Valley. The results were so promising that an intensive program of study was conducted during the 1946 season to determine the relative effectiveness of various materials, formulations, and concentrations and to develop satisfactory methods of application. In addition, certain basic observations were madeon the node of action of the new formagenic phytocides. There follows a summary of these studies and the results obtained.

During the seasons of 1945 and 1946, investigations were carried out on the use of 2,4-D for the control of plants which create malaria control problems in the reservoirs of the Tennessee Valley Authority. The investigations involved detailed studies with sixteen plant species and general observations with sixty-six additional species, comprising a total of twenty-four woody and fifty-eight herbaceous plants. Certain basic studies were also made on the general effects of 2,4-D and related substances on plants and on the extent of absorption and translocation and residual action in various species.

Materials tested included 2,4-D dusts and the sodium salt, triethanolamine salt, methyl ester, and butyl ester of 2,4-D. The dusts were applied in 10 percent 2,4-D concentrations at treatment rates of 2.5 to 10 pounds 2,4-D per acre in hand applications and 2.5 to 5 lbs. per acre in airplane applications. Sprays were applied at dosages of 1 to 3 lbs. per acre in concentrations of 0.5 to 5% 2,4-D in hand treatments, 0.1 to 1.5% in applications by ground and boat power equipment, and 20 to 72% in airplane treatment. Compressed air sprayers were used for the hand applications and a portable power sprayer for boat application and ground application with a special command car spray rig. Airplane dusting and spraying was by means of the Authority's standard Stearman and Vultee larviciding units.

Certain species appeared to be highly susceptible to 2,4-D and could be effectively controlled at dosages of 1 lb. 2,4-D per acre; these included ragweeds, cocklebur, and other stiff-stemmed terrestrials as well as lotus and black willow. Other species were highly resistant and difficult or impossible to control with a single treatment of 2,4-D; these included the grasses, cattail, lizard tail, woolgrass, and buttonball. Still other species were intermediate in susceptibility, and these included alligator weed, cowlily, weak rush, and dianthera. The eighty-two species studies were tentatively classified in the above three groups (high, intermediate, and low susceptibility). There was little evidence that any of the materials tested gave superior control with the possible exception that somewhat better results were obtained with the sodium salt on cocklebur, with the methyl and butyl esters on lotus, and with the methyl ester on lizard tail.

On the basis of the results obtained, it is believed that the use of 2,4-D will provide a more effective and economical means of controlling certain problem species such as lotus, black willow, and most of the stiff-stemmed terrestrials. Airplane application appears to be the most satisfactory method for area treatment of species such as lotus with ground, boat, and hand application being most suitable for smaller patch treatments. Great caution should be exercised in the use of 2,4-D in the vicinity of highly susceptible crops such as cotton.

## FRIDAY MORNING SESSION

The Friday Morning Session was called to order at 8:30 A.M., December 3, 1946 in the Ball Room at Hotel Savery by the chairman, Ross Fleetwood.

Mr. Fleetwood. This is our last day of the conference and many will probably be anxious to leave for home so we shall get started on time. First, let us hear from L. W. Kephart on "Proposed Weed Research Program in the West".

## PROPOSED WEED RESEARCH PROGRAM IN THE WEST

L. W. Kephart

Illustrated talk (informal) before the North Central Weed Control Conference, Des Moines, Iowa, December 13, 1946.

The last session of Congress appropriated a moderate sum to the Bureau of Plant Industry, Soils, and Agricultural Engineering to cooperate with the Bureau of Reclamation, Department of the Interior, in research or methods of controlling weeds under the conditions peculiar to irrigated farming. The appropriation was made available because of the very serious situations which confronted all operators of irrigated land, of which the Bureau of Reclamation has supervision of about one-seventh.

Acting under this authorization, the Department of Agriculture is about to install three experimental units in Washington, Idaho, and Arizona and has assigned one man, to the Chemical Laboratory, Bureau of Reclamation, Denver, Colo.

Several kinds of work are contemplated, but the problem for which there is most urgent need is more information about aquatic plants that grow in the beds of the canals and drainage ditches. If not destroyed, these plants impede the flow of water and seriously interfere with the operation of an irrigation district. The plants are of fifteen or twenty species, the most common being several kinds of pond weed (Potamogeton). The present methods of controlling these aquatics are largely mechanical. In very serious infestations, the canal or ditch is cleaned with a dragline dredge, an operation so expensive that it sometimes approaches the original cost of construction. A second, and quite effective method where the topography permits, is to drag a very heavy chain, such as a ship's anchor chain, along the bed of the canal by means of two caterpillar tractors moving along the opposite banks. The chain may or may not have a section of heavy disk harrow attached to it. The chain and harrow drag and cut the weeds loose from the bed of the canal and the mass floats down the stream to be caught on a series of grates where men with pitchforks throw it on the bank in huge piles. Chaining is merely a palliative which does not cure the condition, and growth may return completely within six months.

One chemical process employing a substance known as "Benoclor" has been tested in various places and, while it does a pretty good job of destroying many of the species of aquatics, the details as to dosage, cost, and other items have yet to be worked out.

A second type of maintenance problem on canals is concerned with the mixture of grasses, weeds, and shrubs that grow along the canal banks. The species vary from semi-aquatics along the ditch edge to desert shrubs along the outer sides of the banks. Cutting, flaming, crushing, and treatment with chemicals have all been employed, but success is hardly more than moderate with any of them. Recent

experiments with 2,4-D give more promise than any practice heretofore tried, but this doubtless will answer only part of the problem, and continued testing w will be necessary.

Aside from the ditches themselves, many weed problems which you in the North Central Area have been battling for years are equally serious on irrigated soils and in some instances more so. The deep-rooted perennials, for example, are often harder to kill under irrigation than under nonirrigation. Bindweed, or wild morning glory as it is known in the West, is found nearly everywhere from Canada to Mexico. Most persons who have tried straight cultivation report that the practice which has met such success in other places is almost hopeless as a means of controlling the pest on irrigated soils. Indeed no method is practicable which will keep such valuable land out of production, and since crops can compete fairly well with bindweed when there is plenty of moisture, few farmers on irrigated land feel warranted in trying to kill it by cultivation methods. Something else must be found.

One of the most interesting weed situations in the West is in the Columbia River basin area in central Washington. This is the land that will be watered from the Grand Coulee dam before many years. It is an immense region, now mostly desert or semi-desert, but with large areas of very fertile volcanic soil of enormous potential production capacity. The Bureau of Reclamation is keenly aware of the fact that they have here a wonderful opportunity to start a new reclamation project with a clean slate so far as weeds are concerned. All they need to do is to exterminate the present small patches of weeds growing along the water courses. There is little to fear from water from the Columbia River because it passes through deep lakes in Canada that probably remove all weed seeds

Many of the people who will be working on this project are well known to the members of this Conference Mr. F L. Timmons will be in general charge, Dr R. S. Rosenfels will be at the Denver Chemical Laboratory of the Bureau of Reclamation, Mr. Lewis S Evans who for many years was in charge of the bindweed research project at York, Nebraska, will be in charge of the reclamation project at Phoenix, Ariz.

We extend to each of you an invitation to visit any of these projects whenever you are in the West. Their problems and yours, while differing in details, are identical in the broader aspects and each has much to gain from the other.

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Mr Fleetwood: Thank you Mr. Kephart. Now let us go on to Mr. Balcom. His report is on "Weed Research Program in the Bureau of Reclamation".

## Weed Control Program of the Bureau of Reclamation

R. B. Balcom

Mr. Chairman, Members and friends of the North Central Weed Control Conference. The Bureau of Reclamation is glad to participate in a meeting of such great importance to the welfare of American Agriculture.

It was suggested that this discussion be on the research program of the Bureau of Reclamation but it is more fitting that we discuss our weed control program and set forth the problems created by weeds in irrigation agriculture. We do not have a staff for weed research but are cooperating with the Bureau of Plant Industry, Soils and Agricultural Engineering for this phase of the program. Mr. L. W. Kephart, Senior Agronomist in charge of weed investigations for the Department of Agriculture also has charge of our cooperative research about which he is prepared to give you more details.

The semi-desert lands which have been transformed by irrigation into thriving farm communities are perhaps a small part of the total agricultural development of the United States, but nevertheless a very important part of the agricultural economic structure of the semi-arid west.

There are about 22 million acres under irrigation in this country, of which approximately five million acres are irrigated with water from projects built by the Bureau of Reclamation. Gross value of crops produced on lands served by Bureau projects in 1945 was in excess of $435,000,000.

To more fully develop and conserve the water resources of the arid West, the Bureau is launching the largest construction program in its history. Work is scheduled on some 30 irrigation and multiple-purpose projects in the 17 Western States. With completion of projects now authorized by Congress, more than 11 million acres will be brought under irrigation. The rate of progress in developing new irrigated lands will be dependent on an appropriations and the economic needs of the Western States.

Bureau projects, in addition to harnessing rivers for irrigation and power production, help to prevent floods, furnish municipal water supplies, aid in conservation of fish and wildlife and provide recreational facilities. Reservoirs created by Bureau dams such as Boulder, Coulee and Shasta have a storage capacity of more than 66 million acre-feet of water. Irrigation canals built by the Bureau, if laid end to end, would cross the continent five times.

Close to a billion dollars has been invested thus far in Federal Reclamation projects, which will be repaid to the United States Treasury by water and power users, except for amounts allocated to flood control, navigation and similar functions.

During the past several years, the Bureau has been "taking inventory" of water resources in the West. Careful and comprehensive studies are being made of development potentials in each of 15 major river basins. Construction of the projects included in this "inventory" if authorized by Congress would provide irrigation for about 21 million acres, of which half would be new land. Almost 200,000 irrigated farms would be created for settlement by veterans and others. Projects already authorized and being developed by the Bureau include the million-acre Columbia Basin Project in Washington, the Central Valley Project in California and the comprehensive Missouri Basin Project.

The States of North and South Dakota, Nebraska, and Kansaswhich are included in the North Central Weed Control Conference are a part of the Missouri Basin and plans are going ahead for irrigation developments in these States. Oklahoma, another conference state is also receiving the benefits of irrigation. Inasmuch as a large part of the irrigation developments in these states is comparatively new perhaps the weed leaders who will have to combat weed problems in that area will be especially interested in hearing how some weed problems under irrigation differ from other weed problems and what is being done to solve them.

Considering the present development and plans for future development of western irrigation agriculture it is not difficult to see why the Bureau of Reclamation has taken such an active interest in so important a problem as weed control. This interest stems primarily from the Bureau's general interest in the welfare of its project farmers and its obligation to safeguard the Government's extensive investment in Federal irrigation projects.

Weed control problems under irrigation are naturally divided into two general divisions, those of farm land, and those of the irrigation ditches. While all crop land weed control is closely related to good farming practices, perennial noxious weeds cause more concern and require more advice on control methods than do common weeds. For this reason, the Bureau of Reclamation has given more time to the educational program of noxious than of common weed control. The actual weed control work on private farm land is performed by the farmers independently or in cooperation with organizations such as weed districts set up for that purpose and is not undertaken by the Bureau. However, being very near to our project farmers through settler assistance programs, we are in a position to take an active part in analyzing farm weed problems and in advising on the desirability of weed control and on effective methods. Every effort is made to coordinate our educational weed control program with those of other agencies or organizations interested in this important work. It is aimed at aiding all supplementing the activities of the Extension Service through County Agricultural Agents, State Colleges Experiment Stations, State Departments of Agriculture, and weed districts. A weed control specialist in each of the seven regions of the Bureau work directly with these organizations and discuss with them how we may best cooperate.

There are several factors pertaining to irrigation farming which, unless proper precautions are taken, make the farm land problems more intense than in areas which depend on natural precipitation Perhaps there is no place where conditions are as favorable for weed growth as in irrigated fields. Water is applied to crops as often as needed throughout the entire growing season and thus there are no dry periods to bring about dormancy. This not only creates exceptionallygood conditions for the spread of noxious weeds from roots, but also for germination of seed. Like many crops weed plants produce a heavier yield of seed under irrigation. The irrigation channels which carry the life-promoting water to thirsty fields may also carry weed seeds to infest those same fields.

Some of the noxious weeds found on irrigated farms are the same as those prevalent in the North Central States. The field bindweed, Canada thistle,

Russian knapweed, leafy spurge, silver leaved poverty weed, perennial sow thistle, and white top are some of the most important noxious weeds and infest considerab acreage throughout the irrigated West. There are a few noxious weeds peculiar to the south, such as camel thorn, blueweed, white horse nettle, and Johnson grass, the latter being the most widespread and troublesome.

Besides the weeds considered noxious, irrigated farms are beset with the usual common weeds which increase crop production costs. Poisonous weeds, such as a whorled milkweed and water hemlock, found on irrigation projects take their toll of livestock each year and cockle bur and burdock, cause serious dockage to wool and pelts.

It can be said in general that farm land weed control under irrigation is much the same as elsewhere. Clean cultivation, known also as shootcutting, cropping methods, and chemicals such as carbon bisulphide and sodium chlorate, are all used. At present, the new growth regulating chemical, 2,4-D is being tried and shows promise of replacing more costly means of weed control. The soil sterilants such as chlorates can perhaps be controlled better under irrigation. It is not necessary to wait for rains because water can be applied at the proper time to carry the chemicals into the soil. After the chemicals have served their purpose, irrigations can be used to leach them from the root zone of crop plants.

Much of the area included in the North Central Weed Control Conference does not have to contend with weeds on or in irrigation channels.

In contrast with the farm land weeds, ditchweeds are the direct responsibility of the irrigation district and the control of such weeds must be undertaken by the district's maintenance crews.

Weeds on irrigation ditches may include noxious perennials and many common weeds found on farm lands, as well as several kinds not usually associated with cropped fields. These latter include species of willows and tamarisk and in the South, giant reed grass (Arundo donax), locally called cane or bamboo. Also, many plants such as water grasses, water hemlock and sedges, which are suited to moist soil conditions, grow at the waterline of the ditches.

The advent of 2 4-D has opened up a new field of chemical control in such situations and test applications have given good initial results.

Several irrigation projects have developed burning equipment for controlling ditchbank weeds, where mowing is not practical. With the aid of a long boom fitted with a burner head or jets operated from a truck on one bank, both sides, even in comparatively deep cuts can be cleared. This method has been successfully used on the All-American Canal- the largest irrigation channel in the U.S.

Willows and other shrubs are often burned or grubbed. Recent tests with ammonium sulfamate also have given good results in willow control. Many miles of willows have been sprayed with 2,4-D formulations this year and the results have been so satisfactory that a more comprehensive program using this method will be initiated next season.

Many of the ditchbanks are being seeded to grasses to compete with the re place weed growths.

For convenience in studying waterweeds and their habits and possible control methods the Bureau has divided waterweeds into three classes - floating, emergent and submersed The only floating weeds which are troublesome are water lettuce and water hyacinth which are both confined to Southern projects. Emergent weeds include tules cattails, parrot-feather, water primrose, and watercress The most troublesome is the submersed type which includes pondweeds, horned pondweed coontail milfoils, muskgrass or stonewort, water star grass, spinynaiad waterweed and Algae.

The submersed species are by far the most prevalent and troublesome and are found in both drains and distribution ditches Heavy infestations of emergent and submersed species so reduce the capacity of the channel that it is often difficult to furnish sufficient irrigation water to farmers. When the water is checked up above the normal flow line the amount lost in transit due to seepage is increased which wastes water and contributes to waterlogging of land When drains become clogged with weed growths their efficiency is seriously impaired which may increase alkaline and seeped conditions on the farm lands.

Because waterweed problems are generally confined to irrigation, drainage, navigation and recreation, the methods of solving them are not as widely known as those for farm land weeds For this reason, some of the principal control methods used under irrigation are briefly described with the hope that it may benefit weed leaders in this conference.

Floating plants are largely eliminated by mechanical means. They are either caught behind wire netting screens or behind structures and forked or raked to the bank. However floating plants respond well to chemical treatment and this method has been investigated as you will learn later from Mr. Evan on his work on hyacinth control.

The rooted emergent plants as a whole, have persistently resisted efforts of economic control Mechanical, chemical and burning methods have been used, particularly for tules and cattails which are by far the most numerous and widespread of this group. When cattails are cut off under water several times during the growing season they weaken and die The number of cuttings required depends on the depth of water above the cut surfaces. Many chemical tests have been made on emergent water plants but in general, 2,4-D has given the most promising results.

Of the submersed waterweeds the pondweeds, or Potamogeton species are most widespread among the most difficult to kill, and usually create the greatest problems.

Shutting the water off and allowing the ditch to drain and the weed growth to dry out is perhaps the most economical method now known for controlling

submersed acquatics. Usually 3 or 4 days of hot weather and sunshine are sufficient to kill the stem and leaf system of the plants. This process may have to be repeated several times during the season because the roots are not killed and regrowth may be quite rpaid. In larger canals, drying may not be practical and it cannot be used in drains.

A method known as "chaining" is the most popular mechanical control for submersed acquatic weeds where it can be used. The ends of a heavy chain, are attached to a tractor or truck on each ditch bank. The equipment moves slowly along the banks with the chain following in the bottom of the channel in a long curve. From one to three round trips are necessary to break the weeds loose, the number depending on the kind of weed, the density of infestation, and the stage of the weed growth. One to five chaining operations are required per season.

Many other types of equipment such as weed saws underwater sickles, special discs, canal rakes, ditchdozers, weed forks, and harrows are employed to a limite extent. In some instances, the waterweed growths become so heavy that it is necessary to resort to draglining or dredging.

Chemicals, such as arsenic compounds, and copper sulfate, have been tried for controlling submersed acquatic vegetation. However, it has been deemed too hazardous to use arsenic in irrigation systems and while copper sulfate has long been used in controlling Algae so far no method has been found for obtaining satisfactory results with this chemical on higher types of plants.

The most recent development is chemicals for control of submersed waterweeds and by far the most successful in flowing water is the chlorinated hydrocarbon, known commercially as Benoclor 3C. It is practically nonsolube but added agents cause it to form a rather stable emulsion in water.

The usual first step in application procedure is to reduce the velocity and volume of the water in the channel. This gives the chemical a longer contact time with the weeds and produces a higher concentration with less material. The chemical is sprayed under pressure through nozzles 2 to 4 inches beneath the surface of the water. It forms a white emulsion which is carried with the rent. The amount applied at this first station depends on the size of the ditch, the k kinds of weeds present, and density of growth but whatever the determined amount, it is applied over a period of at least an hour to give proper contact time. The concentration of chemical is eventually depleted by absorption and through breaking of the emulsion and settleing of the chemical. Workmen follow the chemical downstream and when the concentration falls below a killing dosage, they add sufficient chemical to insure an effective concentration. This process is continued until the desired length of channel is treated.

In most instances, the capacity of a treated ditch is restored within 48 hours. The plants usually settle to the bottom and break up and disintegrate so slowly that no congestion at structures results. Some species of waterweeds are completely killed but a least a part of the root system of pondweeds.

remain alive and send out new growth. However, the length of time which the channel is kept open is much greater than after mechanical removal of the plants.

The nature of this discussion has made it necessary to deal with the more difficult weed problems confronting irrigation districts but there is much brighter side to the picture. Like many other activities, weed control has been curtailed by the war but special efforts are now being put forth to overcome the gains weeds have made during this period of labor shortage. The organization of the Bureau of Reclamation into seven regions has permitted a more intensive study of weed problems and a more comprehensive cooperative program of control. A cooperative weed prevention program conducted through the farsightedness of the officials of one division of a Bureau project, settled about 16 years ago, has kept noxious weeds down to less than four acres on farm land and less than one-half acre on the irrigation rights-of-way. The existing infestations are all being controlled and regular weed surveys are made to find any new patches. The new units of the Missouri Basin Project can profit by this example and the weed leaders of this conference from the States in which the project lies can be assured that we will give them all possible cooperation.

The whole outlook on weed control in the United States is very encouraging. Recent advancements made by research groups in the Federal and State Department of Agriculture State College Experiment Stations, chemical companies and by other weed leaders throughout the country has not only increased the total knowledge of weed control but has stimulated weed consciousness and more research. The progress being made is reflected in the formation of important organizations such as the North Central and Western Weed Control Conferences. The good which these organizations can do through research and advice and in raising weed control to its proper status is immeasurable.

It is realized that much more basic research is need on the control of waterweeds and other special weed problems peculiar to irrigation. Perhaps the greatest encouragement which both Federal and private irrigation projects has received in the possibility of developing more economic and permanent methods of solving their weed problems is the research to the conducted next season by the Staff of the Bureau of Plant Industry, Soils and Agricultural Engineering, including such men as Mr. F. L. Timmons, Mr. L S. Evans, And Dr R. S. Rosenfels under the direction of Mr. L. W. Kephart. Mr. Kephart will be able to give you more details of this research program which, while aimed at irrigation weed problem, there is no doubt that some of the findings will be applicable to weed problems in the North Central States.

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Mr Fleetwood. Thank you Mr. Balcom. Mr L. S Evans, I believe, you are next. Mr. Evans has some colored slides to show us.

Mr. L. S Evans showed colored slides on "Water Hyacinth Eradication with 2-4D".

Mr. Fleetwood. Thank you Mr Evans for this beautiful illustration. It was very interesting indeed.

Mr. Fleetwood. Our good friend from Canada Mr. H. E. Wood is going to give us some information on "Leafy Spurge Eradication Program in Canada".

## ERADICATING LEAFY SPURGE BY INTENSIVE CULTIVATION

Mr. H. E Wood
Chairman, Manitoba Weeds Commission

Of the group of deep-rooted persistent perennial weeds, leafy spurge is the most widespread and troublesome in Manitoba. Although not identified as such until 1922, it since has been established that the weed was introduced from Europe, probably in seed brought over by immigrants nearly seventy years ago. A recent surveyindicated more than 1,500 farms with upwards of 20,000 acres infested with leafy spurge. Chlorate, chiefly in the form of Atlacide, has been used for nearly twenty years, mainly on small and scattered patches. Since 1940, the campaign of eradication has been intensified under a system of Weed Control Units which employ trained spray crews, with modern equipment, that go from farm to farm treating the less extensive infestations without cost to the farmer, the municipality and the Provincial Government assuming the expense involved.

My remarks will be confined to the problem that extensive infestations of leafy spurge present, especially when met with on the better class of arable soil. Municipal authorities, and we of the Manitoba Weeds Commission, soon after our spray programme got under way in 1940-41, realized that steps would have to be taken to combat the larger infestations--on some farms a few acres, on others sometimes a hundred acres or more. The research and experimentatin conducted by a number of your State Experiment Stations with field bindweed, and especially the programme then getting underway in Kansas, pointed the way to an approach to our poblem.

Our first move was to put teeth into our Noxious Weeds Act which our Legislature did promptly, and in a satisfactory manner. An amendment gave to the municipality--similar to your County, although considerably smaller in size--the power to take over for a period of five years any property infested with one or more of the deep-rooted persistent perennials; to proceed with a programme of eradication; to crop the land as necessary and desirable, thereby reimbursing for outlays incurred. A provision was made in this legislation allowing a municipality only expenses and taxes if these were not paid, with any surplus being returned to the property owner. This forward looking legislation was deemed necessary, as in the majority of cases when weeds of this group are encountered they are found on "problem" farms operated by "problem" farmers.

Involved as we were in war when this legislation was passed, together with the scarcity of tractors, farm implements and help, it was not anticipated that many properties would be taken over by municipalities. Rather surprisingly, however, municipal officials have been very ready to take advantage of this method of bringing leafy spurge infested property under "intensive cultivation". Since 1942, we have had 10 municipalities take over 13 properties totalling 1,325 acres. Except on two of the larger undertakings where tractors and imple-

ments were purchased by the municipalities, the work has been by contract, local farmers doing the work under direction of the municipal weeds inspector.

Our experience with this method of control justifies at least the three following statements:

1. That "intensive cultivation" carried over a two or three year period, or alternated with cropping, will eradicate leafy spurge.
2. That on reasonably productive soil the undertaking should involve little if any, final expense to the municipality.
3. That, with few exceptions, the job will be carried out more successfully by the municipality than if left to the owner or tenant.

To be successful, intensive cultivation is dependant upon the following underlying principles:

1. Continuance of cultivation for a period sufficiently long (at least 2 years) to kill all roots of all plants. Where cultivating and cropping are alternated a longer period is required.
2. Regularity of cultivations from early spring to freeze-up (14-day intervals are recommended, with perhaps a lengthening of periods as the plants weaken after the first year).
3. Thorough work at each operation; this requires suitable implements with cutting edges kept sharp.

On the heavier soils, where soil drifting is not a hazard, cultivation is usually carried on for two consecutive seasons--on a portion of one property, we found it necessary to keep it black forfour seasons. For the lighter soils, we are finding alternate years of cultivation and cropping effective. A quick growing crop, such as barley, is usually selected to follow one season's cultivation. Before planting, the land can be cultivated at least once. Immediately after harvesting, which is usually early in August, cultivation commences again and follows through the next year.

In closing, you may be interested in a few figures. On our largest block --179 acres--the whole was under cultivation for two seasons; 122 acres cropped the 3rd year, the balance cultivated for the 3rd year; in the 4th year 159 acres were cropped, while 20 acres where the spurge was especially persistent, were kept under cultivation for a 4th season. Over 4 years $7,047 has been expended with $8,833 revenue. The value of this land has appreciated from $2 to $3 an acre to over $20. At the end of next year, the 5th year under the plan, we look for the land to be free of leafy spurge. Another municipality with four properties totalling 187 acres under contract, intensively cultivated a 40-acre field of medium loam soil in 1945, and took off a 42 bushel per acre crop of barley. Outlay over two years was $662.45 revenue $1126.90. In midsummer, 1946, this land changed hands for $50 an acre--about the top for that district. Although this field appears to be freed of leafy spurge, cultivation commenced again after the barley crop was taken off, and is to continue through 1947, when it is expected it will be free of weeds. Following strong representation by ratepayers bordering ahalf section estate farm badly infested with leafy spurge, the municipality took it over, purchased a new tractor and culti

vation machinery, hired an operator and commenced work in 1943. After four yea intensive cultivation and cropping, the property is well on the way to being rid of leafy spurge and most other weeds. It is no longer a menace to surroundi farmers. In addition to more than paying its way, the books show a credit balance of $1,000--this land was appreciated in value from being unsaleable at $1,600 to being readily saleable for $8,000.

Mr. Fleetwood. So ends this mornings special program and reports. It is time for our panel discussion on "Proposed Restrictions on the Sale and Movement of Weed Infested Materials". Mr. C. H. Schrader will be the moderator.

Mr. Schrader. Thank you Mr. Fleetwood. Because of bad weather, we are not going to have this panel discussion. I know all of you are anxious to get home so I am going to just give a small report on "Proposed Restrictions on the Sale and Movement of Weed Infested Materials".

REPORT OF COMMITTEE ON FEDERAL LEGISLATION TO CONTROL INTERSTATE MOVEMENT OF NOXIOUS WEED-INFESTED SEED, FEED, AND OTHER MATERIALS--C. H. Schrader

There is considerable interest in some states for federal legislation to re inforce state legislation regulating the transportation between states of mater other than seed which is infested with noxious weeds.

Of the 518 more common and important noxious weeds in the United States, 22 of 44% were imported from foreign countries, Mainly Europe and Asia, and were no here when white man came to settle the country. Of the 15 or more noxious weeds in Class I of the Minnesota Weed Law, only two (Dodder and Horse Nettle) are native to the United States, and only one (dodder) is native to Minnesota. Of the ten more noxious weeds in Minnesota, just one (horse nettle) is native to the United States and none to Minnesota.

When we realize what these data mean and that our weed problem costs us annually about $75,000,000 per state, we have good reason to be concerned about the increase our weed population, both as to kinds and amounts being imported in our country and from one state to another.

Besides the problem of direct importation of weed seeds into the county, we have the more important problem of their distribution throughout the country from the few states and points of direct importation. Few noxious weeds are imported directly from foreign countries to the areas where they have finally established themselves. Most of the infestations arose from interstate transportation rather than from importation from outside the country.

Most states have laws for the protection of buyers of seed moving in both intrastate and interstate commerce. These state laws are supplemented by an excellent Federal Seed Act which attempts to give the states the same protection in interstate commerce in seeds that the states provide for themselves in the sale and transportation of seeds. States get the full benefit of this Federal law only when they have their own adequate laws and inspection and enforcement

personnel which the Federal law supplements. Some states have developed their seed law enforcement to a high degree of efficiency and service. Further attempts to develop and refine seed law enforcement technique and procedure by expenditure of large increases in funds and personnel for seed inspection, will not give results comparable to giving considerable attention to other important channels of weed seed infestation and methods of weed control.

Having taken such definite legal precautions for many years to stop the spread of weed seeds in agricultural seeds sold and distributed by seed dealers it is hard to understand why more attention has not been paid to the problem of weed seeds in farm sale of seeds and the many other important avenues of importation and distribution of weed seeds such as grains, milled feeds, hay, forage, bedding, packing materials, railroad cars, automobiles, etc.

Much of the good work done on weed control through seed and weed laws, as now constituted, is being undone by these other uncontrolled sources and methods of distribution of weeds It is difficult, in many cases, to see that we have actually made any gain in reducing our weed population, but we know that weeds would have been much worse had there been no such control.

Several states such as Kansas, Nebraska, and California have laws regulating the sale, transportation, and importation of other materials than seeds which are infested with noxious weeds. These laws vary considerably in their scope and methods of enforcement.

What is needed now is a Federal law which will supplement state laws for control of different weed infested products the same as the Federal Seed Act supplements state seed laws.

A number of attempts have been made to enact federal laws covering some phases of this problem besides noxious weed seed in seeds which are already covered by an excellent law.

On January 13 1941, House Bill 2086 was introduced. Its purpose was to regulate the importation into the United States, and the transportation in interstate commerce of any feed, grain, or seed screenings, grains, hay, bedding, packing materials, or other material containing live noxious weed seeds unless stated on a label or the invoice that the shipment is intended for processing, cleaning, or manufacturing purposes or that the material complies as to its noxious weed content with the law of the state into which it is to be transported. This bill was not voted out of the committee on agriculture.

Mr Peterson of Florida introduced, on January 21, 1943, House Bill 1396 It required that seeds, livestock, and poultry feed, nursery stock, fertilizer and soil conditioning materials distributed to farmers by the United States government shall be subject to state laws where the distribution is made. This bill passed the House on May 17, 1943 and later the Senate It was vetoed by the President.

On May 26, 1945, the Flannagan bill House Bill 3321, was introduced into the House. It provided that when a department or agency of the United States shall distribute seeds for planting purposes, livestock, and poultry feeds, nursery stocks, agricultural chemicals, including fertilizers and fertilizer materials, soil conditioners or insecticides, it shall be the duty of the officers or employees distributing the same to comply with and be subject to the inspection laws of the state within which such materials are sold, bartered, or distributed, except that the provisions of the act shall not apply to materials furnished to authorized state or Federal experiment stations for purposes, or any manufacturer or any department or agency of the federal government.

The collection of any fees in the several states for the purpose of labeling, inspecting, or analyzing seeds for planting purposes---(and so forth) shall not be construed as a tax against the federal government for any such material--- but as a charge made against the recipient of such materials as a part of the cost thereof, and shall be paid to the proper state authority in accordance with the laws enacted by the several states.

This bill was reported by the agricultural committee, but did not come to a vote.

Two of these bills, House Bill 2086, introduced January 13, 1941, and House Bill 3321, introduced May 26, 1945, contain the principal general basic requirements for suitable federal legislation House Bill 2086, by a number of changes, could perhaps embody the desirable features of both bills. Title I, Section 101 (a) (2) could be extended to include under the term "Person""any unit of government or agency or representative thereof." Title II, Section 201 (a) might be extended to include the material of House Bill 3321. If the two bills for some reason cannot be combined they, with a few modifications, should be reintroduced as separate bills. Your committee recommends that this conference adopt a resolution urging Congress to enact legislation embodying the substance of House Bills number 2086 of the 77th Congress and number 3321 of the 79th Congress, into one law, or to enact separate laws similar to these bills and that each state ask and urge its representative in Congress, both the House and Senate, to support and work for such legislation.

Mr. Schrader. This concludes our morning meeting Mr. Harry D. Linn, Secretary of Department of Agriculture, will open this afternoon's meeting.

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FRIDAY AFTERNOON SESSION

Mr Linn. Weather conditions are still pretty bad so we are going to hurry this along this afternoon Mr. R C Kinch will give us his report.

UNIFORM WEED LAWS
Ray Kinch

1. Weed eradication laws should be separate from and in addition to, the old weed mowing laws now on the statute books of most states.

2 No effective weed program can be started until there has been a general survey of the weed infestation in the county or state and information developed on the seriousness of the weeds so the farmers can be made to become concerned over the situation. Several states have made a preliminary survey with the assistance of the assessors.

3. At the inception of a weed program, education should be relied upon until there is a high voluntary complicance. Although a law should have many teeth to make it effective, its enforcement should not begin until public opinion demands the use of the stringent measures.

4 Weed control and eradication is primarily for the benefit of farmers and of agriculture in general. It is recognized, however, that a great many farmers do not fully realize the actual losses suffered each year from noxious weeds, nor do they realize the potential threat to their farms if these noxious weeds were allowed to continue to spread

5. The definite need for a weed control and eradication law must have been determined before its enactment and it should be endorsed by all interested agricultural organizations and individuals.

PROVISIONS OF A UNIFORM WEED LAW

1. A weed law should set up a central organization whose undivided duty is weed education and control. Adequate funds must be supplied to obtain and retain capable administrators

2. A weed law should provide units of organization either districts or counties, that will be large enough to support a practical program. Small units are to be discouraged The law should be flexible to meet changing conditions and needs

3. A weed law should provide some way whereby officials in charge of the local program would not be subject to local politics This would eliminate disruption of the program a large turnover in officials and the time required in educating new personnel. A farmer board of directors as in a Soil Conservation District may solve the problem.

4. A weed law should provide a central agency with general supervision of education and weed promotion work in the state. This agency should have the enforcement of general provisions relating to the control and eradication work on non-agricultural lands, and the movement of noxious weed infested material anywhere in the state This general supervision should not limit the functioning of local units in their part of the enforcement program.

5 A weed law should permit the action agencies to contract for eradicatio and control work and should permit eradication work on land of non-cooperators.

6. A weed law should definitely provide measurers for raising sufficient funds for the local program.

7. A weed law should contain general provisions relating to the sale, barter exchange or dissemination in any manner whatsoever of any plants or plant products which contain noxious weeds, seeds, or plant parts. General supervision of these provisions should be under the direction of the central agency, but local units should be under the direction of the central agency, but local units should also be given authority to perform the same kind of work.

8. A weed law should have provisions enabling cities and villages to enact ordinances, raise funds for weed control, require eradication, employ such help as needed, and contract for needed work.

Mr. Linn. Now, we shall hear from George Knowles. He is going to give us a report by G. E. Blackman.

## A SUMMARY OF RECENT INVESTIGATIONS ON THE CONTROL OF WEEDS by CHEMICAL METHODS

BY
Professor G. E. Blackman
Department of Agriculture, University of Oxford

In continuation of the investigation initiated in 1942, further direct comparisons have been made of the relative effects of sulphuric acid, copper compounds, nitro-ring compounds - principally dinitro-ortho-cresol (D.N.O.C.) and the derivatives of phenoxy-acetic acid on a wide range of weeds and crops.

The several hundred experiments carried out in 1945-46 by the research team at Oxford confirm that the relative effects of different herbicides are closely linked with (1) the weed species; (2) the stage of growth at the time of treatment. For the control of annual weeds, the 1945 findings are in general agreement with previous results set out in the article in "Agriculture"*. The new evidence emphasizes the changes in resistance of succeptibility from the germinating seed to the flowering stage and stressed that these trends differ and are dependent on both the weed species and the nature of the herbicides.

Further research has shown that copper chloride is still the most active of the copper compounds. Comparisons of the ammonium sodium, potassium, calcium and copper salts of D.N.O.C. with a D.N.O.C. suspension demonstrate that the suspension and the ammonium salts are superior to the remainder, but there again the order of toxicity is related to the weed species. Tests on ammonium 2,4-Dinitro-secondary butyl phenate show that this compound is more toxic to several annual weeds than ammonium D.N.O.C.

The relative potency of methyl-chlor-phenoxyacetic acid (M.C.P.A.) and dichlor-phenoxyacetic acid (D.C.P.A.) is dependant upon the species of annual weed. For some annuals (e.g. Brassica arvensis) M.C. P.A. is effective at lower concentrations than D.C.P.A., for other weeds (e.g. Ranunculus arvensis) this difference is negligible.

*"Agriculture" 1946 - LIII - page 16, "Weed Control in Cereal Crops by Chemical Methods".

In continuation of the investigations on mixed herbicides, the results confirm that this is a complex problem. Synergistic action between D.N.O.C. compounds and the phenoxyacetic acid derivatives - for example-appears to be dependant on the weed species.

The safety limits of the spray concentrations required to achieve truly selective weed control in cereals remain unchanged. The 1946 results stress that damage to cereal may result (i) if spraying is carried out in the young seedling stage; (ii) if concentrations in excess of 0.2 per cent equivalent to 2 pounds per acre-of either M.C P.A. or D.C.P.A. are applied.

The extreme complexity of phytocidal action is well illustrated in the investigations on linseed (oil flax) and flax (fibre flax). Within definite limits of concentration and stage of growth at the time of spraying, copper chloride, M.C P.A. and D.C.P.A and the sodium salt of D.N.O.C. can be employed for weed control in linseed. The same recommendations cannot be put forward for flax since whereas these compounds may have little effect on the yield of seed and straw they may greatly decrease the yield of fibre. It has been shown that this loss of fibre is a complex interaction dependant upon the state of growth, the compound and the concentration.

From the initial trials in 1943 on the comparative effects of M.C.R.A., ammonium sulphamate and sodium chlorate on the control of Cirsium arvense, Rumex crispus, Rumex acetosella, Urtica dioica, the investigations have been extended to cover most of the important perennial weeds in Great Britain. The investigations stress (i) that weed species vary greatly in their reaction to different compounds; (ii) that the state of growth is of the highest importance; (iii) that the results in grassland may differ from those obtained in arable land.

On the question of the inter relationship between species and compound it has been shown for example that whereas Ranunculus repense and R. acris are susceptible to M C.P A. and D.C.P A., R bulbosus is largely resistant. There is also evidence that for some species M C.P.A. is more effective than D.C.P.A. (e.g. Cirsium arvense) but the reverse is true for others (e.g. Seneccio Jacobai

The paramount importance of the stage of growth at the time of spraying has been repeatedly demonstrated for a number of weeds. Trials on C. arvense and Convolvulus arvensis stress that the greatest efficiency occurs if spraying is carried out under hot dry conditions when the flowerbuds are well defined: under such conditions over 90 per cent kills, based on counts in the following year, have been achieved. For other weeds such as Ranunculus repens early spring spraying is most effective. The resistance of some perennial weeds is dependant on their age and development, seedling plants of S. Jacobaea or Rumex obtusifolius are susceptible to M.C.P.A. and D.C.P.A., whereas mature plants are not.

For some species repeated applications of either M.C.P.A. or D.C.P.A. at relatively short intervals are needed to bring about complete eradication -e.g. Bellis perennis. Such treatment on grassland leads to the elimination of a great reduction of the legumes. By, however, a careful timing of the spraying,

by limiting the spray concentration, and through proper grazing management, control of the more susceptible perennial weeds has been achieved without permanetly reducing the clover content.

Other investigations being undertaken at Oxford include studies of the effects of ethyl phenyl carbamate and allied compounds. Once more it has been shown that the toxic effects are related to the species and stage of growth. The grasses are most susceptible in the germinating or young seedling phase but there are marked specific differences. Species susceptible in this seedling phase may, however, become largely resistant when they are established plants - e.g. Avena fatua. Some dicolyledonous seedlings are resistant e.g. linseed.

On problems concerned with the use of light mineral oils for selective control of weeds in umbelliferous crops, it has been found that different oils vary greatly in their effects on the weeds and the crops. It has been demonstrated that the selective action is not related to the "total aromatic" content of the oil "per se". It has also been shown that emulsions may have a greater or smaller effect than the oils themselves and that these differences are dependent on the species.

Apart from these specific problems the general programme in the Department is concentrating on (i) the principles of phytocidal action including the physiological and biochemical aspects, and (ii) the nature of weed competition.

## APPLYING 2,4-D WITH AN ATOMIZER ON MUSTARD IN WHEAT

George Knowles

In the year 1945 when 2,4-D was used for the first time by the Field Husbandry Division of the Dominion Experimental Farms Branch it was observed that mustard and several other species of annual weeds which occur in grain were killed by 2,4-D with no perceptable injury to the grain. The growth of Canada thistle and of field bindweed was retarded by a 2,4-D spray to such an extent that these weeds offered no further competition with the grain.

This was convincing evidence in support of the claims made for 2,4-D as a selective weed killer.

To a grain growing country like Canada, the significance of the discovery of this new herbicide was readily apparent and attention was turned to consideration of how it could be most economically applied. In many sections of the Prairie Provinces where this herbicide could do much good, water is very scarce. It was therefore believed that 2,4-D would not be popular in these areas if it had to be applied in the large amounts of water frequently recommended by some of its manufacturers. It is true that spraying with Sinox to control annual weeds in grain was rapidly being adopted in some of these dry areas and 80 - 100 gallons of water per acre are used in applying Sinox. It was thought, however, that farmers would not want to use more than this amount of water to apply 2,4-D and preferably less, so an experiment was conducted by the Field Husbandry Division to determine if 2,4-D could be effectively applied in smaller

amounts of water. This experiment consisted of applying equal amounts of the same brand of 2,4-D on three equal sized weed plots in three different amounts of water 80, 160 and 240 gallons per acre. The results indicated that the weeds on all three plots were equally well killed. It was, therefore, assumed that 2,4-D could be effectively applied in 80 gallons of water per acre

From the results of this experiment, it was also surmised that the right amount of 2,4-D per acre uniformily distributed may be the important factor in its application and that perhaps the amount of water used in applying it is not important.

There was no immediate thought, however, of applying 2,4-D in less than 80 gallons of water per acre because there was then no knowledge of a broadcast sprayer that could put on less than that amount. Then early in the year 1946 it was learned that minute quantities of spray per acre could be applied by air craft and tentative plans were made to conduct an experiment in the Prairie Provinces in the year 1946 in order to determine the minimum amount of water that could be used to distribute 2,4-D A little later our attention was drawn to another type of machine which could also apply very small amounts of water per acre. This was the Buffalo Turbine Sprayer Duster. It appeared to be a desirable type of machine to use for conducting the experiments in mind and one was purchased.

The Buffalo Turbine Sprayer Duster, as the name implies, can apply either spray or dust and a combination of both. It is an aeroplane supercharger adapted to a peace-time job. It consists of an air tunnel through which air is forced at the rate of approximately 200 miles per hour by means of a high speed fan. At the outlet of the air tunnel jets of liquid - which may contain 2,4-D are injected into the air stream. The high speed air atomizes the liquid and a column of atomized liquid or mist is shot out almost at right angles to the line of travel of the machine.

When dust is used, it enters in front of the fan, is carried through the tunnel and is shot out as a column of dust. At the same time, water to dampen the dust may be injected into this column of dust through the jets already mentioned.

In preliminary tests with the machine at Ottawa, agroxone dust was used. This brand of dust was difficult to control by this machine for it was carried long distances by the strong windblast and the amounts applied were ineffective. Better results might have been obtained if a more concentrated dust had been used. The atomized liquid, however, was much easier to control, so attention was focused on this method of applying 2,4-D.

It was found in these first tests with the turbine that Stinkweed and some other annual weeds present were killed by an atomized liquid containing 2,4-D to a distance of 50 feet away from the machine while travelling at 7 miles per hour. At this speed and taking a width of 50 feet only about five gallons of liquid were applied per acre.

In order to apply a lethal dose of 2,4-D in such a small amount of water a 2% solution of Naugatuck was used. This is the equivalent of a .025% solution applied at the rate of 1 gallon per square rod. Or an actual amount of 500 cc's of Naugatuck per acre.

Naugatuck was chosen because it was completely soluble in water. A powdered brand of 2,4-D was tried first but was discarded because it was not completely soluble and small particles of the undissolved powder collected in the tiny holes through which the liquid is injected into the air stream.

The results from these preliminary tests at Ottawa appeared so promising it was decided to ship this machine to the Prairie Provinces and test it under Western conditions. The Western tests were conducted at the Dominion Experimental Farm, Indian Head Saskatchewan and at the Dominion Experimental Substation, Regina, Saskatchewan.

Based on the tests at Ottawa it was judged this sprayer would not distribute a lethal dose of 2,4-D to a distance of more than 50 feet away from the machine. Preliminary tests at Indian Head, however, showed that mustard could be killed to a distance of more than 60 feet, away from the machine.

There appeared to be two reasons for the ability of the machine to take a wider strip in the West than at Ottawa. There was more breeze in the West also the sprayer was set on a low trailer. At Ottawa, it had been mounted on a rather high truck and the nozzle has to be tilted down slightly. At Indian Head since the machine was low to the ground, the nozzle could be tilted up slightly above the horizontal this enabled the breeze to catch the atomized liquid and carry it further. In subsequent trials 60 foot widths were taken.

In these Western trials, two different concentrations at Naugatuck were used. One a 2% solution applied on a 60 foot strip while travelling at 7 miles per hour. The other a 3% solution applied on a 60 foot strip while travelling at 5 miles per hour. The approximate amounts of liquid applied were, therefore, 4.4 and 6.2 gallons per acre respectively.

At the time these Western tests were made, the wheat was from 6 to 8 inches in height. About 75% of the mustard was in the 4 to 5 leaf stage, most of the remaining mustard had just emerged. Contrary to expectations, the larger mustard plants were the first to show symptoms of 2,4-D injury. The tiny seedlings which had just emerged showed no injury until about three days after they were sprayed. At the end of one week, however, it was apparent that practically a 100% kill of mustard had been achieved by both concentrations of 2,4-D.

The grain which had been sprayed with the 2% solution showed no discoloration or injury. The area which was sprayed with the 3% solution had a very slight yellowish tinge Pictures of the areas sprayed and adjoining areas not sprayed were taken when the mustard was in bloom, these show a most complete kill of mustard, with this exception, when spraying one strip the wind changed momentarily from a side to a head wind. This blew the atomized liquid almost straight behind

the machine. Where this change in wind direction occurred, a "yellow island" stood out clearly in the surrounding green. This emphasizes the necessity of always working with the wind when using this type of machine.

When the wheat came into head some abnormalities were observed in the areas sprayed by 2,4-D. Cereal breeders were quite alarmed over these. It was thought such off-type heads would not be tolerated in a field of registered grain.

There was also some doubt about the germination of the grain in these off-type heads and even if it did germinate the off-spring might also be deformed. In order to find the answer to these doubts, kernels were, therefore, taken from these off-type heads and planted in the greenhouse. It appears from the growing plants that the germination has not been injured by the strengths of 2,4-D used in these tests. At the time of writing the heads have not appeared.

The vast majority of wheat growers, however, are mainly interested in yield and applying 2,4-D in these small amounts of water with an atomizer to control mustard in wheat has increased wheat yields.

The average increase at Indian Head due to all the treatments was 3.29 bushels per acre. At Regina, it was 2.09 bushels per acre.

In view of the fact that this was a year of ample moisture in these two districts, the increases are considered satisfactory. In a dryer year, greater increases may be expected from similar treatments.

Wheat Yields from Areas Sprayed and Unsprayed with 2,4-D
By The BUFFALO TURBINE AT INDIAN HEAD, SASKATCHEWAN, in 1946

| Treatment | Sprayed | Unsprayed | Difference |
|---|---|---|---|
| Field 1 - 500 cc Naugatuck per acre in 5 gal. water | 21.46 bu. per ac. | 17.61 bu.per ac. | 3.85 bu.ac |
| Field 2 - 1000 cc Naugatuck per acre in 7 gal. water | 39.06 " " " | 31.80 " " " | 7.26 " " |
| Field 3 - 1000 cc Naugatuck per acre in 7 gal. water | 22.79 " " " | 20.36 " " " | 2.43 " " |
| Field 4 - 500 cc Naugatuck per acre in 5 gal. water | 34.57 " " " | 40.87 " " " | -6.30 " " |
| Field 5 - 1000 cc Naugatuck per acre in 7 gal. water | 35.03 " " " | 25.82 " " " | 9.21 " " |

Average Increase due to treatment - 3.29 bushels per Acre.

COMMENTS:-

Six square yard samples were taken from the treated and untreated portions of the field, the samples were taken reasonably close together on either side of the divisional line so that they would be as nearly alike as possible as far as soil differences are concerned. The half dozen samples in each part of the field were spread over the entire length of the field so that they should be representative . In conncection with field 4, there was some lodging in this field and it was more difficult to secure samples, this may account for the untreated area showing the highest yield.

Wheat Yields from Areas Sprayed and Unsprayed with 2,4-D
By the BUFFALO TURBINE and BOOM SPRAYERS at Regina Substation in 1946

| Treatments | Sprayed | Unsprayed | Difference |
|---|---|---|---|
| 1000 cc Naugatuck per acre in 7 gallons of water applied with Turbine | 23.72 bus. per ac | 21.3 bu. per ac. | 2.41 bu.ac. |
| 500 cc Naugatuck per acre in 5 gallons of water applied with Turbine | 18.91 " | 19.84 " | .93 " |
| 500 cc Naugatuck per acre in 5 gallons of water applied with Turbine | 23.37 " | 18.56 " | 4.81 " |
| Average Increase on Turbine Sprayed Areas | 2.09 bushels per Acre | | |
| 500 cc Naugatuck per acre in 100 gallons of water applied with BOOM SPRAYER | 17.87 " | 17.87 " | 0 |

COMMENTS:-

You will notice that the application which I considered best - 500 cc per acre - has a slight decrease in yield. I still am of the opinion that this was a very complete and thorough job of weed control and do not attribute this decrease in yield to the application of the spray but rather to locations chosen in random samples.

I did not expect much increase in yield this year due to spraying on account of the ample rainfall during July.

Mr. Linn. Thank you Mr. Knowles of Canada. Our next portion of the program is the Business Session taken care of by T. F. Yost, Chairman.

REPORT OF THE COMMITTEE FOR DRAFTING OF MODEL HERBICIDE LAW
Warden L. Noe, Chairman

Your committee appointed for the drafting of a "Model Herbicide Law" composed of L. W. Kephart, T. L. Aamodt, W. L. Klatt, Henry Lunz, C. A. Stahl, W. F. Hall, and Warden L. Noe have collaborated upon the assignment given to the committee and have conferred with interested parties outside of the committee and herewith submit to the conference the following report:

I. That in the process of collecting material, data, and documents to guide the committee in the formulation of a draft of a proposed herbicide law it studied: (a) H. R. 5645, a bill to regulate the marketing of economic poisonings and devices and for other purposes which had been introduced in the last session of Congress. Passage of this bill failed by reason of its being on the calendar at the close of the Congressional session. (b) A draft of the proposed model Insecticide, Fungicide, and Rodenticide Act proposed by the Council of State Governments.

The provisions of these two acts are in close accord. The Federal bill, in all probability, will be introduced before the 80th Congress in a revised form. The draft by the Council of State Governments has been prepared through its drafting committee of state officials and the United States Department of Justice through its Federal State Relations Section. This bill includes not only insecticides, fungicides and rodenticides but also the subject assigned to this committee, i. e., the regulation, control, registration, distribution, and sale of herbicides.

II. That your committee has concluded that it would be unwise to recommend the drafting and sponsoring of a strictly herbicide law when so much progress has already been made in the preparation and sponsoring of a broad act, one which includes herbicides.

III. That a revised draft of the proposed Council of State Governments, Insecticide, Fungicide and Rodenticide Act, has been adopted by your committee which is in words and figures in the form attached hereto except in the following particulars to wit:

That wherever the term "agricultural chemical" appears in the attached draft there be substituted therefore the term "economic poison". It was the consensus of the majority of the committee that although the term "economic poison" is a misnomer in many respects, it has been defined in several state laws as including products in question; it has been used in the proposed federal law including all such products; it has a recognized meaning in trade circles; that, therefore, it would be unwise to abandon this definition in favor of the term "agricultural chemical".

IV. Your committee desires to report further on two proposed changes which were suggested for consideration, but not adopted by reason of insufficient votes, namely:

(1) That there be inserted in Section 2, j, after the word chemical in the third line the following: "Or in the alternative a statement of the name of each active ingredient together with the name of each and the total percentage of the inert ingredients if any there be in the economic poison provided, however, that the first alternative shall apply if the preparation is highly toxic to man as determined under the provisions of Section 5 of this act".

(2) That there be inserted in Section 4, e, at the end of said paragraph the following: "If, upon receipt of such notice, the registrant insists that such corrections are not necessary and requests in writing that the articles be registered the commissioners shall register the article, under protest, and such registration should be accompanied by a warning, in writing, to the registrant of the apparent failure of the article to comply with the provisions of this act". That a more drastic penalty be provided for law violations, where questioned product had been registered under protest.

(On account of the need to save space and material, we have omitted the suggested act, if you desire copies, they will be sent you upon request.)

On delivery of the report of the committee on the drafting of a "Model Herbicide Law", Warden L. Noe, chairman of said committee, moved that the conference adopt such report. Said motion after being duly seconded, was voted upon in the affirmative by the conference. The chairman thereupon declared said report duly approved and adopted by the conference.

## REPORT OF THE COMMITTEE ON EXTENSION PARTICIPATION
E. P. Sylwester, Chairman

Mr. Chairman, for the published proceedings, I am going to submit a much more complete report on extension weed control activities. In the proceedings, all states will have a report. As I give you a brief summary of extension activities in weed control at the present time, and as the reports appear in the proceedings, I want you to notice the similarity of work done in extension weed control in the several states. The brief outline I am about to give will not appear in the proceedings but will be supplanted by a much more complete report as submitted to me by workers in the states. These reports follow.

North Dakota - L. A Jensen, Extension Agronomist

The weed problem is demanding increased attention each year. No estimates are available as to the extent of loss caused annually by weeds With the larger yields that have been experienced in the recent years due to more favorable moisture conditions, farmers notice the loss caused by weeds even more than in poorer crop years. This is due to the wider spread in yield between a weed free and a weed infested field.

All counties in the state are carrying on some kind of weed control program most of them in some definitely organized manner. Forty-one counties have revolving funds with which to purchase chemicals for resale to farmers. Five counties not having revolving funds, have local dealers handling chemicals. Fourteen counties have county or township money available to promote weed control demonstrations and eradication along highways. Thirty-four counties own 59 dry chemical spreaders, 48 being owned by counties or by townships. Eleven counties own 11 sprayers for chlorate application. Twelve counties have 3 gallon knapsack sprayers available to county agents for carrying on demonstrations. Nineteen counties report 159 Sinox machines privately owned, over half of these are located in three counties.

One of the greatest handicaps to the perennial weed control program has been the shortage of sodium chlorate. The Extension office pooled county orders to make up carload lots and designated the shipping points in the state. A total of 51 tons was distributed in 8 counties.

The chemical company billed the counties according to their share. This procedure worked out very nicely and avoided the handling of any money through this office. In 1946, North Dakota used 250,000 pounds of sodium chlorate, 50,000 pounds of atlacide and 200,000 pounds of borascu.

A joint project between the Extension Service, the Experiment Station and the Bureau of Plant Industry has been worked out to learn the effectiveness of 2,4-D as compared to the standard chemicals--sodium chlorate and borascu on perennial weeds. In this project, we have been especially interested in the control of field bindweed, leafy spurge and perennial peppergrass. This project was initiated in 1945. The applications were made in July and results observed in September. The project was also carried through 1946 when results were observed in June and some retreatments made, with observations made again in September of 1946. Under this plan, the Extension Service arranges for the farm cooperators and assists in making the chemical applications and observations in the field. The Experiment Station and the Bureau determine and evaluate results. This close working relationship affords an excellent opportunity for the Extension Service to maintain a close contact with developments in the field of new herbicides. Plots are located in 10 counties. These demonstrations are well distributed over the state and offer an opportunity for county agents and farmers to observe the results of these various chemical treatments. The large amount of publicity and advertising that has been given to 2,4-D products in the press and farm papers has caused many farm people to be interested in the use of 2,4-D. These plots have definitely served as a means of obtaining firsthand information on the effectiveness of 2,4-D on these weeds in our state. While the results obtained from these demonstrations have not been analyzed and put in published fo the results have been so satisfactory that we are now recommending the use of 2,4-D for the control of field bindweed. Results on leafy spurge, however, indicate that 2,4-D is not effective and we are therefore not recommending its use in the eradication of leafy spurge. The applications on perennial peppergrass in 1945 were made too late in the season and that may be one reason why good kills were not obtained. In one plot, however, where we did apply the 2,4-D at an

earlier stage, the results seemed encouraging. Applications were made in 1946 at an earlier stage of growth than in 1945 and looked somewhat promising this fall. It will not be until next summer, after we can see the regrowth that occurs, that we will be in any position to know what results might be expected from treating perennial peppergrass with 2,4-D.

While annual reports are not yet available from the counties, it is known that many county agents conducted chemical weed demonstrations on both annual and perennial weeds in their counties. This has given the agents in those counties firsthand information and experience on the use of these materials. These demonstrations have also given farmers in the area an opportunity to observe the results.

With the more favorable moisture conditions existing in the state, it is apparent that annual weeds are on the increase. Mustard and wild oats are two of the weeds that have been increasing quite rapidly. The Extension circular prepared by the Experiment Station last year giving suggestions for wild oats and mustard control has been extensively used in the state this year.

The interest in and the use of Sinox as a selective herbicide for the control of annual broad leaved weeds has increased in the state. Sinox is used most generally in the northeastern section of the state. There are about 20 counties where farmers own spray rigs. The following estimates are of interest in showing the increased interest in Sinox machines and the use of Sinox within the state.

| Year | Spray Rigs in State | Estimated Acres Sprayed |
|---|---|---|
| 1943 | 16 | 10,000 |
| 1944 | 43 | 15,000 |
| 1945 | 100 | 25,000 |
| 1946 | 159 | 20,000 |

The 1946 season was very unfavorable as far as the selective spraying was concerned. Two conditions were primarily responsible. (1) An unprecedented heavy spring freeze caused much of the grain to be set back and the weeds to harden off, and (2) The dry conditions which remained through the spring on into June were not favorable for lush rapid weed growth. It is generally recognized that when weeds are not growing rapidly that they are much harder to kill. A good many operators found that they were not able to obtain good results with Sinox this year.

A complete series of trials were conducted in three counties on small grain crops. These demonstrations all involved harvesting and yield determination and were carried through to obtain test weight, kernel weight and germination. Because the number of trials is too small and results are available for only one year it is not possible to draw any conclusions. The results obtained do seem to offer hope that there is a possibility of using 2,4-D as a herbicide on small

grains without obtaining too much injury to the small grain crop. There is much yet to be learned about the time of application, the rate of application, etc. Other plots on wheat gave promise of weed control on a wide variety of annual weeds. The public was invited to visit the plots. On bindweed plots in Durum wheat, hard wheat and barley, no significant differences in kernel weight, test weight per bushel, or in germination were found between treated and untreated areas when several different 2,4-D compounds were used.

This fall, a series of district conferences were held in the state prior to building county programs of work. One of the major programs discussed with county agents at that time was weed control. It was suggested to the county agents that each county should set a definite county weed control committee made up of county commissioners, township officers, action agencies and all other interested groups in the county. This committee should hold an annual meeting to go over the county weed program in detail and work out plans and procedures for the coming year. It should also be the job of this committee to help work out the organization and the procedures necessary to carry out the program which they develop. Such matters as demonstration farms, county office displays, demonstrational material, teaching aids and other methods that could be used in the county were discussed with the county agents.

South Dakota - U. J. Nordgaard, Extension Agronomist & Elmer Sanderson-StateWeed

The present South Dakota Weed Law was passed at the 1945 session of the legislature and became effective July 1, 1945. The educational and organizational phases of the Weed Law and Weed Program were designated as a responsibility of the Extension Service.

The South Dakota Weed Law provides that a weed board shall be established in each county. This board is responsible for the weed program in the various counties to operate in accord with the policies of the State Weed Board. During the winter of 1945 and 1946, the Extension Service devoted its weed activities to the explanation of the State Weed Program and in organizing the county weed boards as outlined by the State Weed Board.

The Extension Agronomist prepared a procedure outline guide or suggestions for all county agents to use in carrying out the educational and organizational work.

Community educational meetings were held in the counties by the county agents. The state weed program and the procedure of organizing the counties for the directing of a county weed program was thoroughly explained. All farmers in the counties received special invitations by letter to come to the meetings. The farmers present at these educational meetings, elected a community weed representatives met and elected from among themselves, a county weed board of three members. The number of educational meetings held in the county varied from 6 to 13, depending on the size of the county and the number of farmers.

Thirty three counties are now organized with a county weed board. It is expected that by the spring of 1947, all Extension counties will be fully organized and prepared to start on an active organized weed control program.

Five State District Weed Meetings were held in April and May, 1946. All county weed board members, county agents, and representatives from non-organized counties were invited to attend. The District Extension Supervisors were in charge of the meetings. The President of the State Weed Board and the two Extension Agronomists presented different phases of the Weed Program. An open discussion was held, giving the county weed board members an opportunity to exchange valuable ideas.

The State Extension Service is now in the process of printing colored picture bulletins of the eight noxious weeds in South Dakota. They will be printed in sufficient quantity so that every farmer will receive a copy. Color pictures of creeping Jenny, leafy spurge, perennial sow thistle and perennial peppergrass are now completed and counties have, or are now distributing them. The other four noxious weeds, namely; Canada thistle, Russian knapweed, horse nettle, and quackgrass will be printed this winter.

The above is the preliminary phase of the educational and organizational phase of the South Dakota Weed Program, carried out by the Extension Service.

The time is now at hand for the regular continuous work program to be organized in every County of the State. This will come about when the state of South Dakota has provided personnel and facilities to carry out the program as outlined by the State Weed Board operating under the 1945 South Dakota Weed Law.

The counties have been conducting active weed control programs. Increased activity is expected when the State Weed Program, financed by legislative appropriations, is fully developed. Several counties have been sponsoring an extensive demonstrational program on the use of various herbicides. Sodium Chlorate and Borax were applied extensively on small patches of weeds with good results. Considerably more chlorate would have been used if it had been available. Soil Conservation districts are cooperating in the control and eradication of large infestations of noxious weeds by cultural methods through established weed rings.

As can be judged from the above account, Extension Service, charged with the educational and organizational phases, will play a major role in the South Dakota Weed Program. The program is being developed on the principle that farmers will cooperate in a voluntary organized program and that weed eradication by compulsion will only have to be used in rare instances.

Nebraska - N. S. Hanson, Extension Agronomist, and Loys F. Smith, State Department of Agriculture

Educational activities in weed control in Nebraska are carried on cooperatively between the Extension Service of the College of Agriculture and the Division of Noxious Weeds of the State Department of Agriculture and Inspection.

Information for the eradication and control of noxious weeds is obtained through the weed Research Project of the Agronomy Department. This information is presented to the various communities by representatives of the Extension Service and the Division of Noxious Weeds, through:

Arrangements for educational meetings are usually made by the County Agricultural Agent and the information presented by State Department of Agriculture and Extension specialists by means of weed infestation charts, movie film, slide and general discussion.

Demonstrations sponsored by Extension Service and the Division of Noxious Weeds for the purpose of showing eradication and control methods as well as results.

Tours of weed experimental farm outlying test demonstrations plots and of cooperators' farms for the purpose of gaining information on weed control.

Weed displays and displays of control and eradication materials for the development of weed consciousness are shown at State and County fairs as well as other places where large agricultural gatherings are expected.

An extension project whereby a state truck loaded with display material on various phases of agriculture is taken for a few days engagement in many counties Weed display material as well as information on weed identification is presented.

Correspondence, preparation, and distribution of extension circulars, radio talks, and news releases are other media through which weed control education is carried on.

To further the educational weed program and to bring about more complete cooperation in the control and eradication of noxious weeds, the Nebraska State Weed Law, under the supervision of the Division of Noxious Weeds of the State Department of Agriculture and Inspection, provides for the organization of noxious weed districts. Once these districts are organized, the Division of Noxious Weeds and the Extension Service have a direct contact with the farmers in the various communities through the weed district supervisors and the district weed program.

To the present time there are 69 weed districts organized in the state. In the last year most of these districts have incorporated the use of 2,4-D in their weed programs as a result of information compiled and distributed cooperatively by these two agencies.

Kansas - T. F. Yost, State Weed Supervisor

1. Weed program a joint activity between State Department of Agriculture and the Department of Agronomy at the State College
2. County Agents cooperate in advisory capacity in planning all county weed control programs and activities, tour stops, meetings etc.

3. Joint weed tours sponsored by the State Department of Agriculture and the Department of Agronomy.

4. Weed and weed seed identification primarily by the Department of Agronomy.

5. Publications on weeds by both State Department of Agriculture and the Department of Agronomy.

6. Joint meetings contacting people on district, state and county levels.

7. Joint weed meetings contacting county agents, supervisors, county commissioners.

8. Training schools for county agents on district and state levels for weed supervisors and county commissioners.

9. Conducting county weed plot test on chemicals.

10. Joint activity in distribution of literature, preparation of bulletins, radio, and other forms of activity.

Oklahoma - Clyde Bower, Director of Entomology and Plant Industry Division of the Department of Agriculture, and Wesley Chaffin, Extension Agronomist.

The principal work of the Extension Service in weed control in Oklahoma has been the dissemination of timely and useful information concerning some of the most troublesome weeds, together with methods of control. We have also emphasized basic methods and practices in weed control. The use of planting seed which is free from objectionable weed seeds, crop rotation, and good tillage practices are all strongly emphasized throughout the state. Demonstrations in the control of Johnson grass and certain other objectionable weeds with sodium chlorate have been conducted annually for many years. During the past two years, tests have been made with 2,4-D in several counties. This chemical effectively destroys many of the annual weeds, but results which have been obtained thus far do not justify unqualified recommendation of 2,4-D for bindweed control.

Bindweed, Johnson grass, and dodder are the most serious weed pests in Oklahoma. Cheat is also a serious weed pest in the wheat section of the state. The agronomists have cooperated with county agents in holding meetings in several counties during the past few years to discuss proper weed control practices. Bindweed is rapidly spreading in the state, and a more intensive weed control program is being developed at the present time.

Minnesota - Ralph F Crim, Extension Agronomist

1. Weed work in Minnesota is cooperatively between the Extension Service and the State Department of Agriculture.

2. Joint County weed meetings, attended by State Department of Agriculture representatives, Extension Service specialists, county agents and lay people. Presentation of weed law and methods of weed control.

3. Preparation of mimeographed material, used at meeting, for correspondence etc.

4. Leader training schools jointly sponsored.

5. Weed control demonstrations, joint undertakings between Extension Service, Experiment Station Bureau of Plant Industry of the State Department. During the winter months of 1946, Mr. Armour and I attended as many county weed meetings

as we could possibly schedule. These were in cooperation with the State Department of Agriculture, the Extension Division and county agents. Mr. Armour and I gave those in attendance the very best and latest information on weed control. We had the material prepared and left mimeographed copies with those in attendance. You might call this a leader training meeting of county agricultural agents, county commissioners and others who attended. Important demonstrations were outlined, as well as important subject matter on weed control methods, seed production, weed seed distribution, etc. It was generally felt that the meetings were very much worthwhile.

Iowa - E. P. Sylwester, Extension Botanist and Plant Pathologist, and Clyde Spry Assistant Secretary of Agriculture.

In weed control, all counties were helped by correspondence and publicity. Modern methods of weed control and weed law enforcement were presented to all counties in a series of seven district meetings. These meetings were sponsored jointly by the State Department of Agriculture and Extension Service, and were attended by County Extension Directors, County Weed Commissioners, County Supervisory Boards, Soil Conservation Technicians and Vocational Agriculture Instructors. These meetings were well attended and contacted all counties of the state and served to bring the educational leaders as well as enforcement officials up-to-date on weed control methods and enforcement. In addition, four district extension program planning meetings were attended by the weed control specialists and featured the general plant industry program (including weed control) to the lay leaders of the state. Four district 4-H camps, including the statewide camp at Mitigwa, were contacted on weed work and so all counties of the State were contacted in 4-H work in regard to weed control. In addition to district weed meetings already mentioned, 48 counties were given additional specialist help in weed control, in the form of general weed meetings, night schools, spraying demonstrations, leader training, or supervisory board meetings Six of these 48 counties were helped two or more times with meetings. Thus, weed control work was taken to more counties on a personal meeting basis than ever before. In addition, there were eight district weed exhibits held, featuring weed control in all its phases; such as smother crops and chemicals. These were held in conjunction with fairs and plowing matches, with gratifying attendance. Similar exhibits were held at seven field stations, again with good attendance. These exhibits brought all phases of weed control to the public in a visio and audial way. On all phases of weed control work, we enjoyed the best of cooperation from the Experiment Station and from other Extension departments; such as Agronomy, Horticulture, Publicity, Entomology, Soil Conservation, Agriculture Engineering, etc., and from the State Department of Agriculture. In all, 149 meetings on weed control contacted 9,331 people, most of whom were leaders in their respective communities. In addition, the State Department contacts county supervisory boards, weed commissioners, auditors, etc., in regard to weed work. Ten radio talks and fourteen publicity articles were given wide dissemination on a system of transcriptions and newspaper exchange service worked out by the Publicity department. There were, in addition, 1,661 first-class letters written in response to plant identification and control, and a great deal of time was spent preparing exhibit material, in conferences, interviews

and in committee work featuring weed control work in Iowa. One major article in Farm Science Reporter was reprinted and given wide circulation. One lawn bulletin embracing weed control was given wide circulation. In addition, other mimeographed material was given wide publicicity.

Numerous experiments and demonstrations embodying weed control in various counties of the state, especially the 2,4-D compounds, have shown that these materials are beyond a doubt going to be extremely helpful in all weed control work in the future. On deep rooted weeds, they are not 100% effective in one application, but beyond doubt they will be extensively used in the future for control of weeds in growing crops, along fence rows, roadsides, etc. For lawn weed control they are outstanding. With the 2,4-D compounds, and other weed killing chemicals now already in existence, such as contact sprays, there is no doubt that if we will, (as soon as equipment and labor become generally plentiful), the people of Iowa, by working together, can make the weed problem in Iowa negligible. The future for weed control has never been brighter than it is right now.

The State Department of Agriculture is influential in enforcement of the weed law and has cooperated in every respect in the educational and law enforcement program. The State Secretary of Agriculture serves as a state weed commissioner. Seed inspectors, working under his direction, are influential in stopping sales of illegal seed. The seed laboratory of the State Department and the laboratory at the college cooperate in analyzing seeds.

Missouri - J. Ross Fleetwood, Extension Specialist in Field Crops.

The agricultural extension activities in weed control in Missouri during 1946 were confined pretty largely to pure seed work, the use of sodium chlorate on bindweed and Johnson grass, and the study of the place of 2,4-D compounds in weed control in the state.

The usual methods were followed in the seed and chlorate work, but the 2,4-D work was more in the nature of experimental demonstration work.

Something over 200,000 pounds of sodium chlorate were used on bindweed and Johnson grass. Demonstrations were established on the use of 2,4-D on one or more weeds.

The work of the specialist who devotes time to this acticity of weed control is supplemented by news stories and releases in addition to mimeographed material. District meetings were held to keep agents informed on weed control, especially on the use of 2,4-D. However, neither the time of county agents nor specialists permitted the devotion of effort that the importance of the project deserves.

Wisconsin - George Briggs, Extension Specialist in Field Crops

In the research activities, various men have been carrying on experiments in weed control with truck crops, cranberries, and on field crops, mostly from the standpoint of the use of chemicals.

The extension activities have been carried on mostly by myself in cooperation with county agents who also, in some places, have been staging many demonstrations. For better use of a demonstration spray outfit, I have put on approximately 300 demonstrations in 30 counties, and in many of these areas there have been result demonstrations by county agents of which I have no complete record as to number. These so-called demonstrations have been carried on on roadsides, school yards, cemeteries, fair grounds, and on cultivated fields, as well as pastures and meadows inacessible to regular large spray outfits.

The demonstration outfit that I have been using is equipped with an 8-foot boom, as well as connections for either one or two hoses. The hose that I have been using has been about 80 feet long. For nozzles, we have been using the flat type spray, from regular commercial concerns like the Monarch Sprayer Company, and also other types of nozzles including one, homemade, from an ordinary zerk fitting. In some counties, we find local people have made up a good many little signs with the wording, "Weed Demonstrations with 2,4-D." I have been carrying on my work in cooperation with Dr. Buchholtz, who is doing the research. No attempt has been made to compare types of 2,4-D. However, records of complete activities have been checked on blanks especially prepared for the purpose.

Also I have, as an extension activity, helped start out some spraying of mustard and wild radish with outfits with booms, using in the mustard and wild radish fields, Sinox and Dow's Selective. Also I have met with many committees in the State that are formulating county programs and mapping out suggestions for county and township control programs. Also with the state weed commissioner I attended meetings of county officials as chairmen and weed commissioners, setting forth some of the activities in which they could partake. By colored pictures we showed the responses that they might get from different farm practices through rotations, cultivations and use of different chemicals.

Illinois - Charles Keltner Illinois Superintendent of Plant Industry

The Illinois Seed Law requires that all agricultural seed sold for seeding purposes must be labeled. Producers of seed are not exempted Farmers therefore submit seed samples to their state laboratory to get the information necessary for labeling and sale. Each report of these samples gives complete weed seed content by name and quantity. In this way, many farmers become more conversant with facts about the weed populations in their fields.

The Illinois Department of Agriculture and the Extension Service of the University of Illinois during the past summer conducted weed control county meetings in which methods of control were discussed. Additional meetings were held by the Extension Service alone.

In a large "State of Illinois" exhibition tent, a seed and weed exhibit was used at the Illinois State Fair and at County fairs throughout the entire fair season. More than 500,000 citizens viewed this exhibit. Attendants were present at all times to answer questions and explain the meaning of the exhibit. Another

exhibit covering weed control was shown at the recent International Livestock Exhibition. This year's exhibit seemed to be exceptionally useful when judged from the number of persons who stopped and discussed weed control problems with the attendants. All above weed control work was supplemented by radio and news releases, mimeographed material and other published material.

Michigan - B. H. Grigsby, Associate Professor of Botany

There has not been an official extension program in weed control in this state. However, a considerable amount of extension work has been done right along with the research activities. The following outline gives in brief the essential points of the program in Michigan.

1. Published weed control folder (Extension Folder 88).
2. Exhibit, in traveling unit, of various weed control chemicals. Extensively used at meetings, fairs, exhibits.
3. Demonstration spray applications in areas where certain weeds are of importance, arranged through county agricultural agents. The most important ones were as follows:
    1. Bindweed in oats
    2. Perennial sow thistle in oats
    3. Wild mustard in oats
    4. Bindweed in corn
    5. Horse nettle in corn
4. Demonstration spraying for control of poison ivy on school grounds and public parks.
5. Demonstration spraying for the control of pollen formation in ragweed. This was done in cooperation with the Michigan Department of Health.
6. Discussions at meetings of weed control measures in various local area.
    1. Weeds in asparagus and other canning crops
    2. Weeds in carrots and onions
    3. Weeds in lawns and parks
7. A number of radio programs on weed control measures.

Indiana - Oliver Lee, Extension Botanist

Demonstrating new chemical weed control practices and conducting a survey of weed problems were major activities during the past year. Other phases of the project were seed selection, plant identification and miscellaneous activities.

Chemical Weed Control

1. Demonstrations on various weeds, lawns, bindweed, Canada thistle, poison ivy, garlic.
2. Demonstrations for the control of weeds in corn.
3. Assistance to county agents in establishing spray rigs on custom basis. Advice on size of sprayers, nozzles, etc.
4. Correspondence, radio, exhibit at State Fair, news articles, and Extension news reports aided general public and agents.
5. Publication (New Lawn Weed Killer).

6. Demonstrations on use of Sulfuric acid in onions, Stoddard solvents for carrots and parsnips. Saving of 80% in weeding costs.

7. Mimeographed on this subject - discussion at meetings, assistance in spray equipment.

8. Twelve county demonstrations where onions, carrots, parsnips are raised commercially.

9. When spray equipment becomes available, much spraying will be done.

Survey of Weed Problems

Commission of five members appointed by governor to study weed problem. Study importance of weeds, distribution, present weed control legislation, weed control in other states, educational methods in weed control, and held seven district meetings to ascertain reaction of farmers to weed control. Commission prepared a complete report, briefly outlined as follows:

1. Bindweed, thistle, Johnson grass, sow thistle, garlic, spreading rapidly, endangering agricultural welfare of the state.
2. Present weed control legislation inadequate for needs.
3. Need suitable legislation to control major weeds. Education needed.
4. New chemicals and weed control methods make possible a good program.
5. Need for weed control is apparent in Indiana. Enabling legislation for weed control sought.

Seed Selection

1. First line of defense against weeds is good, clean agricultural seeds.
2. Impure seed introduces new weeds. Meetings on use of clean seed.
3. Importance of weed seed identification stressed at meetings.
4. Contest for clean seed, weed seed identification for 4-H groups.

Plant Identification

1. Identified approximately 1200 weed specimens for farmers.
2. New weed discovered (star thistle, Centaurea solstitialis).
3. Weed identification contest, prizes for 4-H groups.

Miscellaneous activities

1. Exhibit on weed control at State Fair.
2. Kodachrome slides for illustrated lectures by specialists and county agents.
3. Four magazine articles, sixteen radio scripts, two circulars.
4. Meetings of specialized groups, highway commission, agricultural conference, turf improvement, muck crop growers, etc.

Ohio - D. F. Beard and C. J. Willard, Professors of Agronomy

In addition to a number of agronomy projects in which cultural recommendati are included for weed control, farmer meetings were held in a few counties where weed control chemicals and other measures of eradication and control were discussed.

Twenty-five field demonstrations in five different counties were conducted in cooperation with county agricultural agents. These demonstrations were set up to bring out both the possibilities and limitations of 2,4-D as a controlling chemical. Both dust and spray were used in most of these demonstrations. A few of the more impressive observations follow:

1. Masking of bindweed by crop or weed overgrowth was a decided limiting factor in the effective application of 2,4-D.

2. Much heavier dosages than have commonly been recommended were promising on many of the weeds such as Canada thistle, horse nettle, Indian hemp, etc.

3. Two complaints were voiced on the poisonous effect of foliage that had been treated with 2,4-D. One was a laxative and paralytic effect on milk cows that had grazed treated alfalfa-bromegrass, and the other a hog that had allegedly been killed after eating treated miscellaneous weeds in barn lot. Pastures treated elsewhere gave rise to no serious after-effects.

4. Treating with 2,4-D invariably was more effective than mowing, even when applied to mature growth on which treatment is not recommended. Canada thistles treated at the bloom stage with a heavy dosage were laid low for the remainder of the season. Sparce, feeble sprouts reappeared, but in small numbers and they never did attain full size last season.

5. Bindweed, both field and hedge, was effectively controlled in oats when treated after the oats had fully headed.

6. Dust appeared to be equally as effective as spray in all instances. In some cases, there was evidence that the dust was actually superior because it filtered through dense foliage better than a surface spray.

7. Farmer reaction to the demonstrations was very favorable and enthusiastic where dust could be used. There was very little interest on the part of most farmers in the spray methods. Dusting captured their interest and attention in every case. Reasons for this were:

   (a) The lighter load and handling of material

   (b) The ease of reaching weed patches and of applying 2,4-D non-destructively in large fields of growing crops.

To carry spray solution and apply it to rather inaccessible and remote patches is out of the question. A duster loaded with 2,4-D dust works ideally in such situations.

8. One application of 2,4-D is obviously insufficient to eradicate any weed under Ohio conditions. Regrowth of Canada thistle and field bindweed was evidenced, no matter how feeble this regrowth was. This suggests the possible use of a partially pelleted dust mixed with the ordinary dust to give a product with both immediate and sustained effect. If small pellets the size of buckshot could be developed resistant to leaching or breakdown by the soil, sun or other factors, the effect of a double treatment would be secured by one application.

Publications

Killing Weeds with 2,4-D - Control of Johnson Grass
Eradicating Quack Grass with Chemicals
Suggestions for Eradicating Quack Grass by Cultural Methods

Mr. Chairman, this completes the reports of extension activities in the various states. Some of the state reports are extremely brief as submitted by the authors, others had to be briefed to some extent. If there are any questions on the reports that anyone may have, the authors can be contacted directly. Let me say also that I have received the best of cooperation for all states and authors who have cooperated in making this report of extension activities. The extension committee in its meeting also went on record to express the following resolutions to the North Central States Weed Control Conference:

1. That this briefing of extension activities be continued and enlarged by including a report from the Canadian Provinces and such other states as might attend the conference as guests. The length of each state report would of necessity have to be brief and discuss outstanding, unique, and successful accomplishments.

2. That extension workers from the various states be given a definite time on the program at each annual weed control conference to discuss the outstanding accomplishments in their state and discuss and make available to other workers outstanding ideas in extension educational methods in weed control.

3. That research workers be commended for their experimental work, the result of which is the basis for extension education. This is fundamentally sound education.

4. That in order to get maximum results out of an educational program, fullest possible cooperation exist between all departments, such as Extension Service, Experiment Station, State Department of Agriculture, Botany Departments, Agronomy Departments, Soil Conservation Service, Vocational Agricultural Departments, Chemical Manufacturers and Distributors, Equipment manufacturers and distributors, and all other groups interested in weed control. These should not be competing agencies but cooperating forces to fight a common evil, to stop one of the major causes of loss to American agriculture.

5. That more emphasis be given in extension educational work to color and moving pictures to use at meetings, illustrated, brief color leaflets on specific weeds, radio, publicity, mimeograph materials, bulletins, exhibits etc.

6. The committee feels that in general with few exceptions not enough personnel is available, nor enough time of specialists spent in extension work in weed control. Since losses caused by weeds are second only to losses caused by soil erosion, exceeding losses caused by insects, plant diseases, and livestock diseases, the directors of extension in the various states of the conference be informed by their own extension workers that a tremendous need exists for educational work in weed control. This is especially true because of recent developments in all lines of weed control.

7. Extensions' primary job in weed control is to so organize, emphasize, and popularize weed control material so as to get the farmer on all land to do the job, but to help organize community effort to get a uniform job done. It is felt that while tremendous progress in weed control work is constantly being made that we now have materials, in one form or another, by means of which we can now very effectively control and perhaps even banish weeds or cut their depredations down to insignificance, if we will. It is extensions' task to get this job done in the quickest and most effective way.

Mr. Chairman this concludes the report and resolutions of the committee on extension participation. I move the adoption of this report.

Chairman Yost: You have heard the report, and the motion for its adoption. Any comments? Is there a second to the motion? The motion is seconded and adopted.

## REPORT OF COMMITTEE ON RESOLUTIONS

Charles Keltner, Chairman

### Prologue

The North Central Weed Control Conference assembled in Des Moines, Iowa December 11, 12, 13, 1946, re-dedicates itself to a fuller realization of the purpose for which it was established.

The healthy growth in interest in the best methods of weed control and eradication and the increase in the breadth of research and resultant amount of trustworthy information during the past year are matters in which this conference recognized its having not a minor part.

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Whereas:

The North Central States Weed Conference consists of weed control officials of the various states cooperating together and with the Experiment Stations of the various states, and the U. S. Department of Agriculture and members of commercial organizations and

Whereas:

There is need for continued and expanded research for the further study and development of various methods of control or eradication of noxious weeds, and the sufficient funds are not at present available to carry on this research in a manner to speedily attain the extermination or control of these noxious pests and

Whereas:

Weed Control research has never received financial support commensurate with the economic losses caused thereby, and

Whereas:

Funds may be made availabhe for this worthy cause under the provisions of the Hope-Flannagan Act otherwise known as Pulic Law 733, therefore

Be It Resolved:

That a committee be appointed by the President to have noxious weed control included in the list of worthy causes to be supported by funds provided by this act. Such committee to be, and hereby is instructed to prepare the necessary factual information by February 1, 1947, to support a claim for these funds, this information to include an outline of the regional project listing the various cooperating states, Experiment Stations, Governmental agencies or sub-divisions; and outline of research work that has been accomplished to datel and outline of the necessary work that should be undertaken in the future with an estimated cost for the satisfactory completion of this work with details disclosing plans of where, what, and when this project will be accomplished.

Be it further resolved:

That this committee submit these data to the directors of the various experiment stations for their approval by February 1, 1947. Continuing to represent

this conference, transmitting such information through the various officials and agencies including the "Committee of nine" and the U. S. Secretary of Agricultur until the requested appropriation has either been made for the prosecution of this work, or finally rejected.

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Inasmuch as the presence of the seed of common and noxious weeds is usual in uncleaned grains and frequent in concentrated commercial feed stuffs used for feeding livestock, the distribution of these materials is one of the most common means of dissemination weeds.

Be it therefore resolved that legislation be enacted by the several state prohibiting the sale and distribution of grains and seed before they are properly cleaned or processed to remove weed seeds. We further recommend that this legislation be enacted by ammending existing feed control laws in those states having such laws.

Whereas:

The appropriations available to the United States Department of Agriculture for the investigation of methods of destroying noxious weeds are inadequate for the purpose, are inefficiently divided among the agencies of the Department and are not comparable to the funds provided for many other projects of far less social and economic consequence.

Be it resolved that this conference urge the Congress to set up in the Bureau of Plant Industry, Soils, and Agricultural Engineering, a Division of Weed Investigators with responsibility for research in all phases of weed control and to provide such Division with funds sufficient to perform such duties.

Be it further resolved that the Bureau of Plant Industry, Soils, and Agricultural Engineering be informed of this action and be urged as part of this program to investigate the control of leafy spurge, perennial sow thistle and similar pests in the North Central Region, to continue the bindweed research station at Hays, Kansas, and to institute research on Johnson grass, Bermuda grass, and other noxious weeds in the south central area.

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Fully realizing the difficulties, time, and extra effort necessary to entertain and obtain hotel accommodations for a large group under present conditions. Therefore, be it resolved that we acknowledge our appreciation and tha the officers and members of the committees for a job well done.

Be it further resolved that we thank the officers and members of the many committees that have made this meeting so very interesting and instructive; that we thank the speakers that have given so liberally of their time and knowledge to this conference; that we thank the hotels, merchants, and civic organizations of Des Moines for their part in making our stay in their city most enjoyable.

TREASURER'S REPORT - 1946
A. H. Larson

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|---|---|---|---|
| Forwarded from 1945 | $165.00 | Pres. expenses for attending Western conference | $165.23 |
| State Dues | 180.00 | Printing forms for research committee | 108.41 |
| Receipts for convention | 22.82 | Bank deposits charge | 1.00 |
| | $367.82 | | $274.64 |

Net balance.....$ 93.18

REPORT OF AUDITING COMMITTEE

December 11, 1946. The accounts of the treasurer of the North Central Weed Control Conference have this day been audited by the undersigned and found to be in proper form and correct.

Signed-A. L. Bakke
W. W. Worzella
Henry Lunz

President Yost. This concludes our 1946 meeting of the North Central Weed Control Conference. The motion is in order we adjourn.

A motion was made, seconded and carried.

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REPORT OF THE DELEGATE TO THE WESTERN WEED CONTROL CONFERENCE
AT PORTLAND, OREGON ON FEBRUARY 5, 6, AND 7, 1947.
By Noel S. Hanson

The ninth annual meeting of the Western Weed Control Conference was held at Portland, Oregon at the Multcnomah Hotel on February 5, 6, and 7, 1947. Approximately 250 members and guests from the eleven western states were in attendance. Represented were weed research, educational, and regulatory officials from the member states and from the United States Departments of Agriculture and Interior, as well as investigators in fields related to weed control. In addition were technical representatives of chemical companies and their distributors and representatives of companies manufacturing weed treating equipment. The North Central Weed Control Conference was represented by this delegate. The north central states of Kansas and Nebraska were represented by Mr. F. L. Timmons, U. S. Department of Agriculture, Hays Experiment Station, Hays, Kansas and Mr. W. L. Klatt of the Nebraska State Department of Agriculture and Inspection, State Capitol, Lincoln, Nebraska, respectively.

The first day of the conference was devoted to activities of the Research Committee, during which time research workers from the member states and commer-

cial companies discussed their various experiments on herbicides and cultural methods for weed control. During the first day's sessions, a report of the Research committee was prepared which set forth recommendations to the conference which would serve as a guide to the best information on weed control and th use of herbicides available from the member states. This report was presented to and adopted by the conference at a later session. Copies will be available at a later date.

The second day's program consisted of state reports, special talks, and panel discussion. Dr. A L. Strand, President of Oregon State College, gave the address of welcome and pointed out the need for greater research and education in weed control The report from the North Central Weed Control Conference was presented on the forenoon program.

Dr. Essig and Mr. Offord from the Divisions of Entomology and Plant Pathology, respectively, of the University of California pointed out that many destructive insects and plant pathogens have weed plants as alternate hosts. Elimination of the alternate host plants would greatly reduce the incidence of such plant pathologens as bacterial wilts, mildews, and rusts such as black stem rust and crown rust of oats as well as many other diseases. Weed control by either chemical or cultural means can do much in the prevention of spread of diseases and insects.

Mr. R. B. Balcom and Mr. Graham of the Bureau of Reclamation and Mr. L. W. Kephart of the Bureau of Plant Industry outlined some of the cooperative studies on weeds to be conducted on irrigated lands in the area covered by Bureau of Reclamation projects. Mr. Balcom pointed out that the total crop value in the reclamation area in 1946 was approximately 425 million dollars. It was estimated that about 10 per cent, or 43 million dollars was lost in the same area due to weeds on the farmland. He concluded that farms in the western states are losing approximately 200 million dollars from weeds on irrigated land each year due to decreased yields. Weeds on irrigated lands use water much needed by crop plants. Weeds in the irrigation channels cut down the flow of water. The Bureau of Plant Industry program will be one of research and that of the Bureau of Reclamation will be educational. The program will cover 17 of the western states. Any of the State Experiment Stations can cooperate in the program.

A paper prepared by Dr. W. W Robbins of the Botany Division, University of California, was read by Mr. Walter Ball. In his paper Doctor Robbins pointed out that a program of weed eradication by chemical and cultural methods has been initiated at the California Experiment Station at Davis. Some 7,000 dollars annually will be spent by the Experiment Station to control weeds on the 1700 acre experimental grounds. The writer personally visited with Doctor Robbins at Davis following the conference and can report that the use of 30 gallons of diesel fortified by 1 quart of Sinox general per acre or as a wetting spray is giving excellent results in the elimination of mustards, chickweed, star thistle and several weedy grasses not only from fence lines, irrigation and drainage ditches, but selectively from fields of alfalfa as well. This method appears to hold much promise for similar areas in the north central area and should be

tested especially for elimination of many species unaffected by 2,4-D. The fortified diesel fuel has been sprayed successfully by both over the ground equipment and by airplane.

The merits of chemical weed control versus cultural weed control were discussed in a panel. The conclusions of the leaders of the panel were that the method is dependent on the conditions of operation and that a well balanced program should include any or all of the methods, both cultural and chemical, that have been devised.

An informal get-together in the evening at a buffet dinner gave the delegates and guests an excellent opportunity to discuss mutual interests.

A panel discussion on weed control equipment brought out some interesting facts. In general, the conventional type sprayers have been used, but fog applicators and turbine type applicators have also been tried as well as airplane application The discussions brought out a point of agreement by most of those present that the amount of diluent can be greatly reduced and that more specialized equipment will be needed for application. While the fog applicators and turbine machines can utilize very little diluent, the uniformity of application and drift of the chemical are hard to control. Airplane application is proving practical in many areas for the application of 2,4-D in aqueous or diesel fuel diluent and for the spraying of diesel fuels fortified with dinitro compounds.

The writer and others visited with representatives of a company building electric machines for weed control by electricity both when at the Portland conference and also at the company's home office. This visit was in the interest of bringing about more cooperation in the study of this method. It is hoped that in the future more impartial studies can be conducted with this type of weed control and that many of the weed research workers in the north central states may have an opportunity to see and study its principles.

Dr. A. G. Norman of the U. S. Chemical Corps reported on some of the studies on growth regulating compounds by that laboratory. He reported that of the several hundred products tested some with complex formulae showed more effective results than 2,4-D and merit further study. He classified the chemicals studied into growth modifying compounds and growth inhibiting compounds. The growth modifying compounds being less effective as herbicides than the growth inhibitors. It was emphasized that 2,4-D is not a selective herbicide, but rather the differences expressed are differences in relative susceptibility at different stages of growth of the plant in question. It has also been effectively established that a certain dosage of 2,4-D is just as effective in a few droplets per leaf as in complete coverage. Coverage of the entire leaf may actually be wasteful. The amount of the diluent is not important so long as there is a reasonable amount of the chemical applied to the plant. For this purpose much more specialized equipment will be necessary than the present all-purpose sprayers. Doctor Norman also emphasized that the 2,4-D in oil diluent is much more effective on the more resistant plants than 2,4-D in water diluent. In going to the lower volume sprays increased numbers of droplets should reach each plant and there

should be just enough volume to have several droplets reach each leaf. The magnitude of response according to Doctor Norman is the greatest where the droplets reach the younger tissues. The chemical being more readily translocated from the younger to the older tissues. The movement tends to be along with the products manufactured in the leaf.

Dr. W. W. Allard of the Agronomy Division, University of California, reported on studies with O Isopropyl Diphenyl Carbamate which he conducted when with the U. S. Chemical Corps at Camp Detrick. This chemical is a member of the urethan series which was shown some 30 years ago to have growth regulating properties on animal tissues. The O Isopropyl Diphenyl Carbamate was first tried as a herbicide in England in 1944 and 1945. Greenhouse and field tests with carbamate at Camp Detrick showed it to be several times as effective as 2,4-D. The symptoms of treated plants are as follows:

1. The growth stops
2. Leaves turn dark green to bluish green
3. Drying process proceeds down the leaf
4. Some 2 to 3 months are required for the plants to die.

The carbamate at 3 pounds per acre reduced the yield of oats by 90 per cent One and one-half pounds per acre reduced the yield of oats by 78 per cent, wheat 71 per cent, and corn 58 per cent. Most dicotyledonous plants are not seriously affected. Buckwheat and tomatoes were the most sensitive and weedy grasses such as barnyard grass and Johnson grass were very tolerant. Lima beans and sugar beets will stand heavy dosages.

The carbamate has a low solubility and consequently cannot be used efficient as a spray. It should be applied in an inert top dressing to the soil to be carried into the soil by rain. Doctor Allard stated that the place of the O Isopropyl Diphenyl Carbamate as a herbicide might be very limited.

At the business session of the Western Weed Control Conference the following officers were elected for 1947:

President
Mr. Virgil Freed
Department of Field Crops
Oregon State College
Corvallis, Oregon

Secretary-Treasurer
Mr. Walter Ball
California State Department of
Agriculture
State Capitol
Sacramento, California

Vice-President
Mr. Bruce J. Thornton
Department of Botany
Colorado State College
Fort Collins, Colorado

In the Resolutions Committee report of the Western Weed Control Conference it was strongly urged that the conference assist in procuring funds under Public Law 733 for the various experiment stations for weed control research. A resolution was also included which urged the organization of a course in weed control in all of the Colleges of Agriculture. Such a course is already being taught at the University of California.

Another matter of interest to members of the North Central Weed Control Conference is the suggestion that a joint meeting of the Western Conference and the North Central Conference be held perhaps once every five years, the first joint meeting to be held perhaps in 1948 with Denver being considered as a possible central meeting place.

The suggestion has also been made that the two conferences and perhaps the Northeastern Conference (newly organized) sponsor a periodic weed publication to publish papers on weed research, education, and some regulatory phases if funds can be procured to support such an undertaking.

The ninth annual meeting of the Western Weed Control Conference can certainly be considered to have been completely successful, and the officers and committee members should be congratulated for their efforts toward more unified weed control in the several states of that region.

## NORTHEASTERN WEED CONTROL CONFERENCE

C. J. Willard

Dr. Robert D. Sweet of the Department of Horticulture, Cornell University, sent notices of an organization meeting of a proposed Northeastern Weed Control Conference to the Directors of some 14 or 15 Northeastern Experiment Stations and a considerable number of weed workers in that area. The meeting was held at Ithaca, New York, Tuesday and Wednesday, February 18 and 19, 1947. In accordance with the decision of the executive committee of the North Central Weed Control Conference, the undersigned attended as official representative of the North Central Conference.

No program for the Conference was set up before the meeting. Tuesday morning was utilized in having each Experiment Station and commercial organization represented outline the nature of the weed control work which was being conducted, without giving results. Part of the afternoon was spent in an interesting general discussion. However, it soon became evident that more direction was needed to get the most out of the meeting.

Problems of organization were attacked in the latter part of the afternoon. It was formally voted to set up a Northeastern Weed Control Conference. (This name was not adopted until Wednesday afternoon.) A committee was appointed to nominate officers for the current year and another committee to plan a definite program for Wednesday.

After adjournment on Tuesday, Dr. A. M. S. Pridham of Cornell showed many of the visitors his experiments with the toxic action of 2,4-D on cultivated plants. Nearly mature bean seeds from plants killed by heavy doses of 2,4-D, wh dried and planted in the greenhouse, showed unmistakable 2,4-D effects. This ar many other observations raise serious question as to the safety of using 2,4-D on plants intended to produce seed for planting. Probably the hazard is slight with such resistant plants as oats, wheat, corn and other grasses, but until the matter is rather thoroughly explored it would seem to be safest not to use 2,4-D on any plants intended for seed, especially at bloom and the early stages of seed development, and certainly not on broad-leaved plants.

Even very small amounts of 2,4-D carried into a greenhouse devoted to ornamental plants caused abnormalities which destroyed the salability of the plants.

Another observation of Dr. Pridham's is that shrubs and other resistant perennials when treated in late summer and fall may show no effect whatever on the current year's growth but that the next year's growth may be considerably affected. Until we have more experience it would be wise to keep 2,4-D off any perennial you value.

The Aeroil Company gave a demonstration of weed burners at the Agricultural Engineering building before the sessions next morning.

At the general session on Wednesday morning, the nominating committee nominated the following officers for 1947:

| | |
|---|---|
| Chairman | Gilbert H. Ahlgren,<br>Rutgers University<br>New Brunswick, New Jersey |
| Vice Chairman | B. H. Grigsby<br>Michigan State College<br>East Lansing, Michigan |
| Secretary-Treasurer | Robert D. Sweet,<br>Cornell University<br>Ithaca, New York |

These men were unanimously elected.

The program committee recommended that the Conference meet in sections for the morning session. Seven sections were outlined, but only three meetings actually held, one on lawn and golf course weeds, one on field weeds and general agronomic weed problems, and one on the problems of weeds in vegetable crops. Sections on weeds in orchards and small fruits, weeds in ornamentals, aquatic weeds, and weeds in relation to health were outlined, but these meetings were not held because only one or two persons were present who were interested in each of these groups.

Interesting dicussions which it is impossible to summarize here were held at each of the three meetings. At the Wednesday afternoon session, the chairman of each of the morning sessions gave a brief report of the morning discussions.

The remainder of the afternoon session was devoted to organization. Two representatives from industry were selected to constitute, with the three officers elected in the morning, an Executive Committee for the Conference. A Research Committee to prepare suggestions for weed control research for the region was likewise appointed.

In many respects, the weed problems of the northeast are more diverse than those of the north central region - not that the north central region does not somewhere have most of the problems of the northeastern region, but there are many problems which assume far greater importance in the Eastern than in the North Central area. The North Central Conference has not yet held sectional meetings, but the northeastern group after its attempt at a general meeting on Tuesday afternoon went to group sessions at once, and they will probably be the most important feature of any future meetings. In the East, as elsewhere, there is the excited insistent feeling that important developments are on the way and that much more attention must be given to weed research in all fields than ever before. The Northeastern Weed Control Conference is off to an auspicious start.

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## 1947 MEETING

The 1947 North Central Weed Control Conference will be held at Topeka, Kansas December 10, 11, and 12. This meeting will be held in the Topeka, Convention Hall. All Commercial displays will be in the same room where the convention is to be held.

The leading Hotels at Topeka, Kansas where you may make reservations are the Kansan, Jayhawk, and Capitol Hotel.

Program for 1947 Meeting - Chairman
Mr. T. F Yost, Kansas State Board of Agriculture, State House, Topeka, Kansas
Members
Mr. Fred Berggren, Oldbury Electro-Chem. Co., 19 Rector St., New York, N. Y.
Mr. C. H. Keltner, Illinois Dept. of Agriculture, State Capitol, Springfield,Ill.
Mr. L. W. Kephart, Bureau of Plant Industry, U.S.Dept. of Agr. Beltsville,Md.
Mr. George Knowles, Dominion Experimental Farms, Ottawa, Ontario
Mr. F. L. Timmons, U.S. Dept. of Agriculture, Hays Experiment Station, Hays, Kan.
Dr. E. D. Witman, Sherwin-Williams Co. Dept. of Agr. Chemistry, Ohio State University, Columbus, Ohio
Prof. J. W Zahnley, Department of Agronomy, Kansas State College, Manhattan,Kan.

## CONSTITUTION, BY-LAWS, AND ARTICLES OF INCORPORATION

Chairman - Mr. C. H. Schrader, Minnesota Dept. of Agriculture, Dairy & Food University farm, St. Paul, Minn. Chairman to appoint two members to assist in setting up by laws and articles of incorporation.

## WEED CONTROL WEEK

Chairman - Dr. E. D. Witman, Sherwin-Williams Co., Dept. of Agricultural Chemistry, Ohio State University, Columbus 10, Ohio
Vice Chairman - Mr. N. S. Hanson, Dept. of Agronomy, University of Nebraska, Lincoln 1, Nebraska
Members - Dr. A. L. Bakke, Dept. of Botany, Iowa State College, Ames, Iowa
Mr. W. C. Dutton, The Dow Chemical Company, Midland, Michigan
Mr. W F. Hall, Chipman Chemical Co., Bound Brook, New Jersey
Mr. G L. McCall, E. I. DuPont De Nemours Co. Dept. of Agronomy, Kansas State College, Manhattan, Kansas
Dr. L. V Sherwood, Dept. of Agronomy, University of Illinois, Urbana, Illinois
Mr. C. H. Schrader, Minnesota State Dept. of Agriculture, Dairy & Food, Universit Farm, St. Paul, Minnesota
Mr. F. L. Timmons, U. S. Department of Agriculture, Hays Experiment Station Hays, Kansas
Dr. W. W. Worzella, Department of Agronomy, South Dakota College, Brookings,S.D.

## MODEL HERBICIDE LAW

Chairman - Mr. W. L. Noe, Attorney, Kansas State Board of Agriculture, State House, Topeka, Kansas
Vice-Chairman - Mr. Bernard C. Swenson, Minnesota Dept. of Agriculture, Dairy and Food, State Capitol, St. Paul, Minnesota
Members - Mr. Tom Fitzgerald, U. S. Rubber Co., Rockefeller Center, N. Y.
Mr. W. F. Hall, Chipman Chemical Co. Bound Brook, New Jersey
Mr. L. W. Kephart, Cereal Crop and Diseases, Bureau of Plant Industry Station, Beltsville, Maryland
Mr. W. L. Klatt, State Department of Agriculture and Inspection, State Capitol, Lincoln, Nebraska
Mr Henry Lunz, Wisconsin State Department of Agriculture, State Capitol, Madison, 6, Wisconsin
Mr. C. A. Stahl, Michigan State Department of Agriculture, State Capitol, Lansing, Michigan

## INTERSTATE MOVEMENT OF NOXIOUS WEED INFESTED MATERIALS

Chairman - Mr. C. H. Schrader, Minnesota Department of Agriculture, Dairy and Food, University Farm, St. Paul, Minnesota
Vice Chairman - Mr. T. F. Yost, Kansas State Board of Agriculture, State House
Members - Mr. Clyde Bower, Oklahoma State Department of Agriculture, State Capitol, Oklahoma City, Oklahoma
Mr. Clare Buskirk, Nebraska State Department of Agriculture and Inspection, State Capitol, Lincoln, Nebraska
Mr. R. C. Kinch, Department of Agronomy, South Dakota State College, Brookings, South Dakota
Mr. Oliver C. Lee, Department of Botany, Purdue University, Lafayette, Indiana
Mr. Clyde Spry, Iowa State Department of Agriculture, State Capitol, Des Moines,
Mr. H. E. Wood, Manitoba Dept. of Agriculture, Winnipeg, Manitoba
Mr. L. A. Jensen,Extension Service, North Dakota College of Agr, Fargo, N.D.

## EDUCATIONAL ACTIVITIES

Chairman - Dr. E. P. Sylwester, Extension Service Iowa State College, Ames, Ia.
Vice Chairman - Mr. Ross Fleetwood, Extension Service, University of Missouri Columbia, Missouri
Members - Mr. Geo. M. Briggs, Department of Agronomy, University of Wisconsin, Madison, Wisconsin
Mr. J. L. Hutchison, Kansas State Board of Agriculture, Paradise, Kansas
Mr. L. A. Jensen, Extension Service North Dakota College of Agriculture, Fargo, North Dakota
Mr. O. C. Lee, Department of Botany, Purdue University, Lafayette, Indiana
Mr. U. J. Norgaard, Extension Service, South Dakota State College, Brookings, South Dakota
Mr. L. F. Smith, Nebraska State Department of Agriculture, and Inspection, State Capitol, Lincoln, Nebraska

## UNIFORM STATE WEED AND SEED LAWS

Chairman - Mr. Clyde Spry, Iowa State Department of Agriculture, State Capitol, Des Moines, Iowa
Vice Chairman - Mr. W L. Klatt, Nebraska State Department of Agriculture and Inspection, State Capitol, Lincoln, Nebraska
Members - Mr. Clyde Bower, Oklahoma State Department of Agriculture, State House Oklahoma City, Oklahoma
Mr. L. A. Jensen, Extension Service, North Dakota College of Agriculture Fargo, North Dakota
Mr. C. H. Keltner, Illinois State Department of Agriculture, State Capitol, Springfield, Illinois
Mr. L. J. LaPine, The Albert Dickinson Company, Chicago, Illinois
Mr. Henry Lunz, Wisconsin State Department of Agriculture, State Capitol Madison, Wisconsin
Mr. H. J. Mather, Alberta Department of Agriculture. Edmonton, Alberta
Mr. C. N McIntyre, Ohio State Department of Agriculture, Columbus, Ohio
Mr. J F Randall, South Dakota Department of Agriculture, Pierre, South Dakota
Mr. S. Y Roth, Missouri State Department of Agriculture, Jefferson City, Mo.
Mr. C. A. Stahl, Michigan State Department of Agriculture, State Capitol, Lansing, Michigan
Mr. O. A. Ulvin, Minnesota State Department of Agriculture, Dairy, and Food, State Capitol, St. Paul, Minnesota
Prof. J. W Zahnley, Department of Agronomy, Kansas State College, Manhattan, Kansas

## RESEARCH

Chairman - Mr. F. L. Timmons, U. S. Dept. of Agriculture, Hays Experiment Station Hays, Kansas
Vice-Chairman - Dr. C. J. Willard, Dept. of Agronomy, Ohio State University, Columbus 10, Ohio

Members - Dr. A. L. Bakke, Department of Botany, Iowa State College, Ames, Iowa
Mr. V. F Bruns, Department of Agronomy, Canton Bindweed Experiment Farm, Canton, Kansas
Dr. K. P. Buchholtz, Dept. of Agronomy, University of Wisconsin, Madison, Wisc.
Mr. R. S. Dunham, Division of Agronomy and Plant Genetics, University farm, St. Paul, Minnesota
Mr. W. C Dutton, Agricultural Chemicals Section, Dow Chemical Co. Midland, Michigan
Mr. W. C. Elder, Dept. of Agronomy, Oklahoma A. & M. College, Stillwater, Okla.
Dr. B. H. Grigsby, Dept. of Botany, Michigan State College, East Lansing, Michigan
Mr. N. S. Hanson, Dept. of Agronomy University of Nebraska, Lincoln, Nebraska
Dr. E. A. Helgeson, Dept. of Botany, North Dakota College of Agriculture, Fargo, North Dakota
Mr. C A. Helm, Dept. of Field Crops, University of Missouri, Columbia, Missouri
Mr. George Knowles, Dominion Experimental Farm, Ottawa, Canada
Mr. A. H. Larson, Division of Agricultural Botany, University Farm, St. Paul, Minn.
Mr. Oliver C. Lee, Dept. of Botany, Purdue University, Lafayette, Indiana
Mr. G. L. McCall, E. I. DuPont de Nemours Co., Dept. of Agronomy, Kansas State College, Manhattan, Kansas
Prof. T. K. Pavlychenko, Plant Ecology Laboratory, University of Saskatchewan, Saskatoon, Saskatchewan
Dr. L. V. Sherwood, Dept. of Agronomy, University of Illinois, Urbana, Illinois
Dr. L. M. Stahler, U. S. Dept. of Agriculture, Lamberton Bindweed Experiment Farm, Lamberton, Minnesota
Mr. Glen Viehmeyer, North Platte Experimental Substation, North Platte, Nebraska
Dr. E. D. Witman, Sherwin-Williams Co., Dept. of Agricultural Chemistry, Ohio State University, Columbus, 10, Ohio
Mr. H. E. Wood, Manitoba Department of Agriculture, Winnipeg, Manitoba
Dr. W W. Worzella, Dept. of Agronomy, South Dakota State College, Brookings, South Dakota
Prof. J. W. Zahnley, Dept. of Agronomy, Kansas State College, Manhattan, Kansas

Sub-committees

1. Research Projects
Dr. C. J. Willard, Chairman
Dr. B H. Grigsby, Sub-chairman for Northeast Region of Conference
Dr. E. A. Helgeson, Sub-chairman for Northwest Region of Conference
Mr. N. S. Hanson, Sub-chairman for Southwest Region of Conference
2. Uniform Experiments
(One sub-committee for each of the Uniform Experiments. To be assigned by Research Committee chairman).

POLICY ON THE USE OF HERBICIDES

Chairman - Dr. C. J. Willard
Members - Dr. A. L. Bakke, Dr. K. P. Buchholtz, Mr. R. S. Dunham, Mr. W. C. Dutton, Mr. W. C. Elder, Dr. B H. Grigsby, Mr. N. S. Hanson, Dr. E. A. Helgeson, Mr. Geo. Knowles, Mr. Oliver C. Lee, Mr. G. L. McCall, Prof. T. K. Pavlychenko, Dr. L. V.

Sherwood, Dr. L. M. Stahler, Mr. F. L. Timmons, Dr. E. D. Witman, Mr. H. E.Wood, Dr. W. W. Worzella, and Prof. J. W. Zahnley.

Additional Members of the Policy Committee

Mr. T. L. Aamodt, Minnesota Department of Agriculture, Dairy & Food, St. Paul
Mr. Ross Fleetwood, Extension Service, University of Missouri, Columbia
Mr. L. A. Jensen, North Dakota College of Agriculture, Fargo, North Dakota
Mr. W. L. Klatt, Nebraska Dept. of Agriculture and Inspection, State Capitol, Lincoln, Nebraska
Mr. H. J. Mather, Alberta Department of Agriculture, Edmonton, Alberta
Mr. T. F. Yost, Kansas State Board of Agriculture, State House, Topeka, Kansas

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